# SCIENCE ABSTRACTS.

## Section A.—PHYSICS.

**MAY 1905.**

## GENERAL PHYSICS.

920. *Pendulums.* **E. Grimsehl.** (Deutsch. Phys. Gesell., Verh. 6. 19. pp. 284–287, Oct. 15, 1904.)—First an apparatus was made for demonstrating the law of moments of inertia, $Ta = Ts + Ma^2$: a torsion pendulum had moment of inertia $Ma^2$ only when two discs were free not to participate in the movement of rotation round the axis of suspension, and of $Ta$ when these two discs were clamped down so that they must participate in it. The next step was to construct a pendulum which should have moment of inertia $= Ma^2$; and this was accomplished by making the bob perfectly free to rotate round its own centre of gravity, so that it does not rotate round the point of suspension of the pendulum. A. D.

921. *Apparatus for Measuring Lateral Strains.* **E. G. Coker.** (Roy. Soc. Edinburgh, Proc. 25. pp. 452–457, 1904–1905.)—The instrument consists of a pair of arms connected by a deep flexible steel plate, forming a fulcrum about which they can turn. The arms carry screws whose ends bear against the specimen. The relative motion of the ends of the arms causes the rotation of a double knife-edge bearing a mirror, and is observed by means of a telescope and scale. Some values of the elastic constants obtained are given, but present no peculiarity except that in the cases of cast-iron, brass, and copper the stress-strain curve for a complete cycle of stress was a very narrow loop. F. R.

922. *Instrument for Measuring the Flow of Water in Pipes.* (Houille Blanche, 3. pp. 320–321, Oct., 1904. Mois Scientif. Industriel, 6. pp. 697–698, Dec., 1904. Abstract.)—The apparatus of Mesnager and of Parenty are described, both based upon the Pitot tube principle as in Parenty's apparatus for the flow of steam [see Abstract No. 236 (1898)]. The velocity indicated by the Pitot is recorded on a drum, a system of special cams, for counterbalancing the movement of the diaphragm actuated by the excess pressure, making the readings proportional to $\sqrt{h}$. The same pointer arm is attached to an integrating arrangement [see Abstract No. 1018 (1905)], which is geared to a meter train, thus indicating the total quantity of water passed. L. H. W.

**923.** *Testing Machines for Reversals of Stress.* **J. H. Smith.** (Engineering, 79. pp. 307–308, March 10, 1905.)—A photograph shows a vertical machine at Sunderland Technical College, which, acting upon the oscillatory weight principle of Reynolds [see Abstract No. 1302 (1903)], tests two specimens in alternate shear, and four in alternate tension and compression at one time at periodicities of from 2,500 to 4,000 per min. In another machine of the author's design, unbalanced weights are attached to carrier-driven cranks rotating in a bush fixed to the specimen; the latter does not move bodily. The range of stress can be altered by varying the weights and speeds; the upper limit of the range is varied by adjusting a spring. This machine can be used for experiments on wires, the spring being adjusted to eliminate compression. [See also Abstract No. 670 (1905).] F. R.

**924.** *Theory of Relative Motion, with Application to the Problem of the Motion of a Body on the Earth's Surface, and* inter alia *Foucault's Pendulum Experiment.* **A. Denizot.** (Acad. Sci. Cracovie, Bull. 10. pp. 449–485, Dec., 1904.)—This is an investigation of the problem of relative motion in a very general form. We are to suppose a set of rectangular axes of $x', y', z'$ fixed in space with origin O′, and another set of $x, y, z$ with origin O; and O moves relatively to O′, and the co-ordinates of O relative to O′ are $x_0, y_0, z_0$, and are functions of the time, and the direction cosines of the fixed axes relative to the moving axes are respectively $a, b, c, a', b', c'$, and $a''$, &c., which are also functions of the time. Between these $a, b, c$ quantities there exist three relations of the form—

$$a^2 + a'^2 + a''^2 = 1 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

three of the form—

$$ab + a'b' + a''b'' = 0 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots(2)$$

and three of the form—

$$a'b'' - b'a'' = c\,; \quad b'c'' - c'b'' = a\,; \quad c'a'' - a'c'' = b \;\ldots\ldots(3)$$

The author now by differentiation for $t$ introduces three new quantities, $p, q, r$, namely—

$$p = -b\frac{dc}{dt} - b'\frac{dc'}{dt} - b''\frac{dc''}{dt}\,;$$

$$q = -c\frac{da}{dt} = c'\frac{da'}{dt} - c''\frac{da''}{dt}\,;$$

$$r = -a\frac{db}{dt} - a'\frac{db'}{dt} - a''\frac{db''}{dt}.$$

Hence he deduces the theorem of Coriolis, the centrifugal force, which is of the essence of that theorem, appearing with components—

$$m\left\{z(dq/dt) - y(dr/dt)\right\} - 2m\left\{q(dz/dt) - r(dy/dt)\right\}, \text{\&c.}$$

This first investigation applies only to a single moving material point. It is subsequently extended to a system of such points. The latter part of the work contains the application to Foucault's pendulum of the analytical results obtained. In this relation Poisson had expressed the opinion that Coriolis' centrifugal force was too small to sensibly affect the plane of oscillation of the pendulum. The writer explains the difficulty on the ground that if the pendulum is swinging in a plane from north to south, the Coriolis force acts alternately in a direction towards east or west, according as the motion of the pendulum is from south to north, or *vice versâ*, so that there is so far as this cause is concerned no steady rotation of the plane. The writer finally discusses experiments on the deviation (from the vertical) of falling bodies owing to the earth's rotation. He notices also what used to be the received theory (Halley's) of the trade winds, as caused in the northern hemisphere by the northerly current having less easterly velocity than those portions of the atmosphere with which it mixes. This, he says, is now abandoned by meteorologists. Another phenomenon discussed in the same relation is the tendency of rivers whose course is from south to north, or *vice versa*, to erode always (in the northern hemisphere) the right bank. S. H. B.

925. *Precautions Necessary in Investigations of High Precision.* **Loewy.** (Comptes Rendus, 140. pp. 553–558, Feb. 27, 1905.)—The author discusses fully the laborious investigations followed at the Paris Observatory in the determination of systematic errors in various instruments of precision. In the meridian circle certain errors had been long attributed to flexure of the divided circles, but after these had been replaced by discs of cast iron the errors still existed, and were finally traced to the unequal definition of the reading microscopes, which gave different values for the same division setting. Another series of intricate measurements was undertaken with the object of determining the constants of aberration and refraction by the method of placing a double glass mirror before the object glass of the telescope. A difficulty was found in the deformation and general elongation of the stellar images parallel to the axis of the double mirror, and this was at first ascribed to variations of temperature, but later was found to be due to an optical effect depending on the form of the projected outline of the mirrors. An almost perfect compensation was obtained by the introduction of diaphragms limiting the areas of the objective in operation so as to be more symmetrical, and with a new apparatus constructed specially with these precautions it is hoped to obtain a definitive value of the aberration constant. C. P. B.

926. *Air-resistance by Pendulum.* **A. Frank.** (Ann. d. Physik, 16. 3. pp. 464–489, March 14, 1905.)—A pendulum, 12·7 m. long, is swung in a large hall, the bob being hung by four wires from two long spindles on bicycle bearings. The swing is measured on an arc built up of boards and divided into mm., the zero being fixed at a point corresponding to a deflection of the pendulum of 30°, an arc of 6,650 mm. The experimental part consisted in tabulating the decrement of the pendulum for bobs of various shapes for a given number of swings. The weights of the bobs varied from about 5½ to 8 kg., and the friction of the bearings was determined previously by means of a falling weight, and expressed in the equivalent form of a resisting force on the bob. The decrement $\Delta z$, after a double swing, is resolved into two parts, $\Delta s$ and $\Delta\sigma$, representing the respective effects of air-resistance and friction of the bearings, so that after $x$ swings the damping due to air-resistance alone is $\Sigma\Delta s = s = z - \Sigma\Delta\sigma$, in which $z$ is observed and $\Sigma\Delta\sigma$ calculated from the knowledge of the friction. The plotted values of $x$ and $s$ thus found lie on the curve $(a + x)(b - s) = \mathrm{C}$, in which $a$, $b$, and C are constants; $b = 6650$ mm., and $a$ and C are determined from the corresponding values of $x$ and $s$ of one observation. Knowing the constants, expressions are found for $s$ and $\Delta s$, viz., $s = 6650 - \left\{\mathrm{C}/(a + x)\right\}$, and $\Delta s = (6650 - s)/(a + x + 1)$. Other expressions for $s$ and $\Delta s$ are calculated by equating the loss of potential energy of the pendulum to the work done against air-resistance and friction, it being assumed hat the air-resistance varies as $(\text{velocity})^2$, and, the two sets

of values of $s$ being in good agreement, the assumption is held to be justified. In measuring the effect produced by altering the shape of the bob, the symbol employed to represent the air-resistance is replaced by two factors, one for the section of the bob perpendicular to its direction of motion, and another, K, depending on the shape of the bob. In all the cases investigated the relations, $(a + x)(6650 - s) = C$, and $s = z - \Sigma\Delta\sigma$, were found to hold good. The factor K is determined for a number of cylinders and prisms with variously shaped ends, their section being about 0·01 sq. m.; the value of K increases as the ends of the bob are made blunter, being greatest for square-ended prisms and least for cigar-shaped solids, and the expression—

$$\gamma\left\{0{\cdot}582a^2 + 0{\cdot}83(b - a)a\right\} v^2/g,$$

gives the air-resistance of a prism of square section with flat ends, $a$ being the thickness and $b$ the length, $\gamma$ the density of air, $g$ 981, and $v$ the velocity of the prism. A table gives the weights, sizes, shapes, constants, &c., of the fifteen different bobs used. G. E. A.

**927.** *Effect of Electric Waves and of Magnetism on the Elastic Hysteresis of Iron.* **G. Grimaldi** and **G. Accolla.** (Accad. Gioenia, Boll. Fasc. 80. pp. 34–38, Feb., 1904.)—A vertical iron wire surrounded by a solenoid was cyclically loaded and unloaded, the alteration in length being observed by means of a specially constructed extensometer which is described (Ibid. pp. 32–34). The area enclosed by the curve obtained from these readings was found to be diminished when electric waves were passed through the solenoid, sometimes up to 20 per cent. A magnetic field, produced by another solenoid external to and concentric with the first, produced a similar diminution of the elastic hysteresis, but smaller in amount. [See also Abstracts Nos. 1134 and 2685 (1904).] L. H. W.

**928.** *Effects of Momentary Stresses in Metals.* **B. Hopkinson.** (Roy. Soc., Proc. 74. pp. 498–506, March 16, 1905.)—The author finds that iron and copper wires may be stressed much beyond their static elastic limits, and even beyond their static breaking loads, without substantial departure from proportionality of stress and strain, provided that the time during which the stress exceeds the elastic limit is of the order of $\frac{1}{1000}$ sec., or less. By means of a contact and ballistic galvanometer, the momentary extension of a few inches near the upper fixed end of a long wire, produced by a downward blow at its lower and free end, was measured and compared with that given by J. Hopkinson's analysis. In the case of copper wire the observed extensions were about 5 per cent. less than the calculated; possibly the value of Young's modulus for rapid extension is 10 per cent. greater than for slowly applied forces. F. R.

**929.** *Volume Elasticity of Elastic Solids.* **C. Chree.** (Roy. Soc., Proc. 74. pp. 518–523, April 10, 1905.)—A. Mallock [see Abstract No. 2101 (1904)] has given a simple method of finding the bulk modulus by the extension of a hollow cylinder under internal stress. The method depends on the result of mathematical theory, which is now proved in a more complete and direct way, but which at the same time requires to be restricted by certain conditions. Use is made of a formula quoted from Amer. Math. Soc. Bull. 2nd Series, vol. 7. p. 141, 1900, and approximate relations are obtained for several cases. It is shown that a recalculation of Mallock's results now gives the following values :—

| | Bulk Modulus × $10^{-11}$ (C.G.S. Units). |
|---|---|
| Steel, hard | 18·0 |
| „ annealed | 18·3 |
| Brass, hard | 10·6 |
| „ annealed | 10·7 |
| Copper, hard | 18·1 |
| „ annealed | 14·3 |

Not confining himself to isotropy, the author next shows how formulæ of a more general character can be obtained. W. W. H. G.

930. *Dielectric Cohesion of Mixtures of Gases.* **E. Bouty.** (Soc. Franç. Phys., Séances, 3. pp. 137–170, 1904.)—A very large variety of mixtures of gases (H with CO, $N_2O$, $C_2H_2$, O, air ; $CO_2$ with CO) present a dielectric cohesion approximately the same as that of the mean of the dielectric cohesions of the components (except at very low pressures, where the differences in condensibility affect the constitution of the superficial layers). There are, however, exceptions ; mixtures of $CO_2$ with H, or of N with H, have dielectric cohesions less than would correspond to the mean values, and mixtures containing argon present higher values. In any case where argon is present the dielectric cohesion is very small ; and above —20° the colour of the discharge is much brighter than it is below —60°. Either there are two varieties of argon, which tests tend to disprove, or there is condensation of a trace of an impurity between —20° and —60°, and it appeared that this impurity was a trace of ammonia. In a mixture, when one of the gases manifests a visibly preponderating effect upon the spectrum of the mixture, it also tends to impose its own dielectric constant upon the mixture—and this opens out a new field for investigation. The considerable variations in the spectrum and the dielectric cohesion of argon, in presence of mere traces of impurities, raise questions as to whether argon is after all as inert as it has been considered to be. Perhaps the molecules of the impurities act as complex resonators. The theory of ions will not be complete until it comes to include the relation between the dielectric constant and the emission of light from the glow-discharge. [See also Abstract No. 2454 (1904).] A. D.

931. *Capillarity Constants.* **R. Feustel.** (Ann. d. Physik, 16. 1. pp. 61–92, Jan. 26, 1905. Strassburg Dissertation.)—By Cantor's method—finding the maximum air-pressure necessary to maintain an air-bubble of a given size under a given nozzle dipped in the liquid a given depth—the capillary constant of a liquid may be determined with great accuracy. Supercooled liquids do not indicate any singular point in the change of value in the capillary constant upon passing the melting-point. As to the influence of chemical constitution, among benzol derivatives ortho-compounds have the greatest, para- the smallest, and meta-compounds intermediate values of the capillarity constant. A. D.

932. *Surface Tension of a Dielectric in an Electric Field.* **C. Fortin.** (Comptes Rendus, 140. pp. 576–578, Feb. 27, 1905.)—The rise of petroleum between two semi-silvered or platinised glass plates in an electric field is measured. The plates were charged by a transformer giving 42 alternations

per sec. It is shown that the ratio—rise of the liquid/square of field strength—is only independent of the distance between the plates if the change of surface tension be zero. Two results show that, for plate distances 0·0255 cm. and 0·0124 cm., the total rise of the liquid was respectively 0·240 cm. and 0·246 cm. The conclusion drawn is that, in an electric field of 20,000 volts per cm. normal to the surface, the relative variation of the surface tension of petroleum is less than 1/450th. The value 2·08 is found for the specific inductivity of petroleum. G. E. A.

933. *Growth Phenomena in Mercury Drops.* **M. Seddig.** (Phys. Zeitschr. 6. pp. 153–154, March 1, 1905. Phys. Inst., Marburg, Jan. 18, 1905.)—Small, regular, fungus-like formations are sometimes observed on the rubber stopper of a mercury-cleaning apparatus, and may be readily obtained by spurting drops of mercury on to a porous substratum soaked in dilute nitric acid; in this way the growth of cylindrical formations, crowned by a drop of mercury, may be observed. If the experiment is performed near a window, the growths exhibit a decided tendency to incline towards the window, the mercury-cap often falling and forming a number of smaller drops, which then give rise to new growths. When cut through horizontally, these cylinders show a regular, radial structure similar to that of an orange and a central channel passing from top to bottom. The formation of these structures takes place as follows: Where a drop of mercury comes into contact with the substratum containing nitric acid, a layer of basic mercurous nitrate forms which is only difficultly soluble in the acidified water. The outermost particles of this salt become dry and sinter together to a crust, while through the internal, looser portion fresh nitric acid diffuses upwards and forms fresh basic mercurous nitrate below the mercury. In this way the latter is raised, and this action continues as long as the capillarity and evaporation allow. The tendency for the structure to incline towards a window is not due to any action of light, but is caused by increased evaporation and consequent greater contraction on the side near the window. T. H. P.

934. *National Physical Laboratory. Report for the year* 1904 (pp. 3–45, 1905. Electrician, 54. pp. 916–919, March 24, 1905. Engineering, 79. pp. 367–369, March 24, 1905. Abstracts).—Physics Department. *Electricity.*—An inter-comparison has been made of the mercury standards of resistance [see Abstract No. 2009 (1904) and Phil. Trans. Roy. Soc. 204. pp. 57–120, Oct. 15, 1904] constructed last year, and the method of building up resistance coils has been investigated. Build-up boxes have been designed so that the lines of flow are of the same form when separate coils are being evaluated as when they are placed in series; no contacts form part of the resistance measured, and careful checking proves the build-up to be accurate to 0·0001 per cent. Certain anomalies of Clark and cadmium standard cells have been investigated [see Abstract No. 3261 (1904)]. The construction of the ampere balance of the British Association has been proceeded with; the winding of the coils is described, and their dimensions are said to be known with greater accuracy than those of any coils hitherto constructed. Progress has been made during 1904 with the installation of an electro-technical department (equipment described) for testing electrical apparatus on a commercial scale; the equipment should be ready early in 1905. *Thermometry.*—New apparatus installed is described, including wire and carbon tube resistance furnaces, a Moissan long arc furnace, and new thermometer comparison baths. The

chief research has been a study of the resistance and thermoelectric properties of solid electrolytic conductors with a view to a system of high-temperature measurement. Tubular electric furnaces have been constructed capable of continued use at temperatures well above 2,000° C. By means of thermo-couples of widely different properties, very concordant determinations of the melting-point of platinum have been made. The existence at high temperatures, of large thermoelectric forces between rods of various earths made up and treated as ordinary thermo-couples has been securely established by direct electrometric means. *Optics.*—Photometry. Investigations and comparisons of 10-candle Pentane lamps have been completed [see Abstract No. 2945B (1904)]. Variations between different lamps were always under 1 per cent., and mostly under ½ per cent. Standard electric glow-lamps have been compared with the Pentane lamp, and now form the working standards of c.p.; inter-comparisons by means of glow-lamps have been made with American and German standards, and determinations of the ratios of the standards of c.p. accepted in England, France, and Germany are in progress. Photometric tests of the efficiency of two forms of street lighting have also been made. *Steam Research.*—Determinations of the specific heat of superheated steam have been begun by the direct method of measuring the heat required to raise the temperature of a known weight of steam through any chosen interval; the steam is heated by means of an electric current flowing through a coil of wire, and the energy is measured by accurate volt- and ampere-meters. Mercury thermometers have been abandoned on account of the serious changes of zero found in spite of previous annealing, and platinum resistance thermometers have been adopted. A special bridge by means of which temperature observations can be made in 10 sec. is described. W. Ros.

**935.** *Relative Scarcity of Rain on the German Flat Coasts.* **G. Hellmann.** (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 54. pp. 1422–1431, Dec. 22, 1904.)—Examination of 10 years' records from about 200 stations on the Baltic and North Sea shores of Germany shows that the low coast strips immediately bordering the sea receive from 1·5 to 10 per cent. less rain than the lowlands behind. Beyond the sand dunes and where the ground rises this scarcity ceases. The rule also holds for the low shores of Russia, Denmark, the Netherlands, and France. The scarcity is particularly noticeable during the warm summer months, because the conditions for heavy condensation, excessive temperature, air eddies, ascending currents, and thunderstorms are absent on the shore. The coast strips receive most of their rain in October; during the winter the signs of the difference may be reversed. Very heavy showers hardly occur on the shore. The author deals with Schleswig-Holstein in particular. The average mean annual rainfall for Germany, deduced from 10 years' observations at 2,400 stations, is 687 mm.; the western parts of the Empire are wetter than the eastern. H. B.

**936.** *Actinometer Observations on Mont Blanc.* **A. Hansky.** (Comptes Rendus, 140. pp. 422–425, Feb. 13, 1905.)—After citing the varying values given for the solar constant by various observers, the author describes the series of observations he has recently made in the pure atmosphere at the summit of Mt. Blanc. All the determinations were made with the Crova actinometer. Very good measures were obtained during the period July 23–28, 1900, the air being very clear and calm, and the temperature fairly high (— 2° to — 7°); the hygrometric state at the summit was 70 per cent., indicating a vapour tension of 1·2 mm. The maximum intensity of the direct solar radiation was found to vary from 1·72–1·81 cals. in July, and from 1·99–2·02 cals. in September. From all the determinations the value 3·29 cals. is deduced as the nearest true value of the solar radiation constant. C. P. B.

**937.** *Distribution of Actinic Sunlight on Northern Hemisphere at Summer Solstice.* **J. Sebelien.** (Phil. Mag. 9. pp. 351–360, March, 1905.)—After briefly reviewing the work of Halley, Plane, Wieler, Langley, Spitaler, Bunsen, and Roscoe, the author brings together some values obtained by the two latter into tabular form, showing the extent to which the diffused daylight tends to equalise the numbers for the total quantity of light at the different latitudes. It is further shown that while at the equator the effect of the direct insolation on the said day has double the value of the daily effect of the diffused daylight, these numbers will become equal in the neighbourhood of 49° N. latitude, and the further we get towards the north the more the diffused daylight will dominate. Also it is shown that the preference conferred upon the northern latitudes with regard to their actinic illumination at the equinoxes will increase with the declination of the sun, and reach its maximum value at the summer solstice. Then using the formulæ of Bunsen and Roscoe, the present author has calculated the quantity of actinic light which on the *Midsummer-day* falls upon a horizontal element of surface from sunrise to sunset for every tenth degree of latitude. The resulting values are also plotted graphically. It should be stated that the investigation only refers to that part of sunlight which produces the well-known effect on the explosive mixture of hydrogen and chlorine, which was the basis of Bunsen and Roscoe's researches. This has its maximum value in the spectral range ½ GH — H, and is produced chiefly by the violet and ultra-violet rays. For investigating the effect of rays of other refrangibility reference is made to the formulæ proposed by Andresen. C. P. B.

**938.** *Horizontal Pendulum Diagram obtained during a Wind Storm.* **F. Omori.** (Mathematical and Physical Soc., Tokyo, 2. 19. pp. 287–289, 1905.)—On Oct. 10 the barometer went, in 20 hours, down from 770 to 757·5 mm., the wind velocity increased to 14·8 m/sec., and the rainfall of the day amounted to 126 mm. The horizontal pendulum in the earthquake house at Hongo was tilted through 3·5″, while the barometer was low and the wind strong, and the ground regained its position as the barometer rose again on Oct. 11. But the cyclone travelled eastward, and the tilting was to the east; the ground was, therefore, not elevated when subject to a fall of pressure. The author explains this anomaly by assuming that the sea-water accumulated under the cyclone centre, so that the diminished air-pressure was outweighed by a greater pressure on the sea bottom. H. B.

**939.** *Preliminary Note on the Formosa Earthquake of Nov. 6, 1904.* **F. Omori.** (Mathematical and Physical Soc., Tokyo, 2. 19. pp. 290–292, 1905.)—The earthquake killed 145 people, wounded 148, and destroyed totally 490 houses, doing damage to about 3,000 houses. The author points out that the ratio, men killed to houses destroyed, was 1 : 3·4, while it is as a rule 1 : 11 in Japan. Most of the houses in Formosa are built of blocks of hardened mud, which are simply piled upon one another without cementing material, except outside plastering. The bamboo houses were not damaged. Reference is also made to other Formosa earthquakes and their zones. H. B.

**940.** *Meteorites.* **H. E. Wimperis.** (Nature, 71. pp. 81–82, Nov. 24, 1904.)—It is probable that the velocities of meteorites are, by the resistance of the atmosphere, changed by a fractional part of the velocity, which fraction is independent of the velocity of approach; that the superior limit for incandescence is about 150 miles above the earth's surface; and that no iron meteor the original weight of which was less than 10 to 20 lbs. reaches the earth's surface, and that when a meteor does so the temperature of its centre is not in general above that of liquid air (assuming the temperature of space to be absolute zero). A. D.

**941.** *Zodiacal Light.* **A. Hansky.** (Comptes Rendus, 140. pp. 355–357, Feb. 6, 1905.)—The paper contains details of observations made on the evenings of Sept. 21 and 22, 1904, at the observatory on the summit of Mt. Blanc. Under the exceptionally fine conditions, it was possible to see that the form of the zodiacal light was a spherical triangle, with its apex near the ecliptic. At the time of observation (8h. 40min. Paris mean time) the height of the apex was 52°; the length of the light, reckoning from the centre of the sun, was 80°, and its width at the horizon 25°. The intensity increased towards the centre, but its maximum was not situated on the ecliptic, being about 3° from it. Three zones were distinguishable in the body of the light: that described above, and of general feeble luminosity; a medial portion slightly parabolic in outline, and a central luminosity in the form of a parabola. As an approximate measure of intensity, the light at 55° from the sun was estimated to be equal to that of the Milky Way, at 40° about double this, and at 30° three times. The colour was very difficult to define on account of the faintness of the light, but it was thought to be white with a trace of green. The paper concludes with various suggestions concerning the probable cause of this phenomenon. C. P. B.

**942.** *Stellar Velocity Determinations at Pulkowa.* **A. Bélopolsky.** (Astrophys. Journ. 21. pp. 55–73, Jan., 1905.)—In his standard determinations of the radial velocities of stars the author has been troubled with various errors, the chief of which were unequal illumination of the spectroscope objectives and the erratic inclination of the spectrum lines with respect to those of the artificial comparison spectrum. The present paper deals with a special series of determinations of the curvature of the spectrum lines, so as to know exactly the error thereby introduced into their inclination, and a number of measurements of deviations apparently due to flexure, which affected the guiding control of the exposures on the stellar spectra. The inclination of the lines was taken to be due to the fact that the photographic rays fall upon the collimator lens obliquely, and thus have a different path through the prisms from that of the rays from the artificial arc comparison. To illustrate the effect of introducing these newly-found corrections a series of velocity determinations of α Bootis are given and discussed. C. P. B.

**943.** *Changes upon the Moon's Surface.* **W. H. Pickering.** (Nature, 71. pp. 226–230, Jan. 5, 1905.)—From time to time various astronomers who make special studies of the lunar surface have intimated their belief that changes of various kinds may be occurring on the surface of the satellite. The present writer, as the result of a long series of special observations in Peru, Jamaica, and California, believes that physical changes do occur, and that they may be classified under three heads, due respectively to (*a*) volcanic action, (*b*) formation and melting of hoar-frost, (*c*) vegetation. The first class is illustrated most forcibly by the crater Linné, which, according to Lohrmann, Mädler, and Schmidt, prior to 1843, had a diam. of between 4 and 7 miles, whereas its present diam. is ¾ of a mile. A new crater has also been announced in the vicinity of Hyginus. The floor of the crater Plato has repeatedly furnished new formations at various times. Pickering's latest observations show the existence of a crescent-shaped bank, 6 miles long by 1 or 2 miles broad, not shown on maps made by A. S. Williams during the period 1879–1890. Turning to the second class of changes, there appear to be numerous examples of formations which would be most simply explained by supposing them to be composed of hoar-frost. It is considered that the strongest evidence that water in the liquid state ever existed upon the surface of the moon lies in the dried-up river-beds, of which the best example lies on the eastern slopes of Mt. Hadley, at the base of the Appennines. Another, discovered only in the summer of 1904, lies about 60 miles due south of Conon. The author also brings direct observational evidence to show that changes in the forms of lunar features, *e.g.*, the small craters Messier and Messier A, may be actually seen to vary with the period of the lunar day. Regarding the third class of variable phenomena, these are stated to be more conspicuous than those due to the former two causes. Reproductions are given in the paper of four photographs obtained in Jamaica in 1901, showing distinct evidence of changes on the crater Eratosthenes with the age of the moon. Every precaution has been taken to exclude any conclusions based on changes of shadow resulting from varying illumination, but after all it is quite certain that intrinsic growths of dusky matter have taken place, and as no mineral is known which could give this appearance, it is ascribed to the growth of vegetation. As the lunation progresses the western portion of the dark area slowly fades out, and the eastern is absorbed in the growing shadows of the lunar night. A more detailed account of the phenomena will be found in Harvard College University Annals, vol. 53. C. P. B.

**944.** *Sixth Satellite of Jupiter.* (Nature, 71. pp. 282–283, Jan. 19, 1905.)—This new satellite was discovered while observations were being made with the 36-in. Crossley reflector at the Lick Observatory during Dec., 1904, and was confirmed by further observations on Jan. 4, 1905. Perrine, the discoverer, states that its distance from the planet on the latter date was 45′, so that it is situated at a considerably greater distance from its primary than any of the other previously known five satellites. Its position angle was 269°, and daily rate of movement about 45″. Its photographic magnitude was 14, so that it is fainter than the fifth, which was discovered by Barnard in 1892. C. P. B.

**945.** *Solidification in the Interior of a Planet.* **Lœwy** and **Puiseux.** (Comptes Rendus, 140. pp. 192–198, Jan. 23, 1905.)—This is a short note concerning the extensive inquiry prosecuted by the authors into the evidence bearing on the physical state of the lunar crust as determined from a minute study of the features of the moon's surface on the photographs taken with the equatorial Coudé at the Paris Observatory. Starting with a short reference to the views of Kelvin, Darwin, King, and Barus, advocating the view of the earth's solidification, as opposed to those of Suess, Lapparent, who think it to consist merely of a thin solidified crust enclosing a liquid viscous interior, the evidence supplied by the lunar formations is discussed and considered to favour the latter opinions. As evidence supporting the idea of gradual solidification from the surface inwards, the successive terrace formations seen in many lunar craters and seas are cited. In almost every case there appears evidence of five successive stages of solidification and consequent retreat of the confined fused materials. Some of the definite objections to this theory of solidification from the outer parts inwards, are discussed and criticised in detail. C. P. B.

**946.** *Secondary Shadow on Saturn's Rings.* **Amann** and **C. Rozet.** (Comptes Rendus, 140. pp. 297–298, Jan. 30, 1905.)—In the course of a series of observations of the planet Saturn at Aosta, in Italy, during the latter part of 1904, a secondary shadow was seen projected on the rings, in addition to the primary shadow of the planet usually visible. It was definitely noted that the new shadow was curved, but in the opposite sense to the primary. The curvature appears to vary irregularly. Sharply defined on the side nearest the planet, the shadow becomes attenuated towards its exterior border; while on drawings made from Dec. 22–27 there is shown a bifurcation of the part of the secondary shadow which was projected on the inner ring. Taking the equatorial diam. of Saturn as unity, the mean distance of the shadow from the edge of the disc was found to be 0·13. All the observations were made with an equatorial of 17 cm. aperture and 2·02 m. focal length, using powers from 157–350 diams., under atmospheric conditions generally very favourable. C. P. B.

**947.** *Depth of Reversing Layer in Sun's Atmosphere.* **Millochau.** (Comptes Rendus, 140. pp. 354–355, Feb. 6, 1905.)—The author has made a series of observations with a specially designed spectroscope attached to the large telescope at the Observatory of Mt. Blanc. The more massive parts of the instrument were made of aluminium in order to reduce the weight, and were made quite rigid. The collimator had a focal length of 0·60 m., and the camera lens a focal length of 0·30 m. The prism had a refracting angle of 30°, and the face furthest from the collimator was silvered, thus causing the beam to return on itself and enter the camera lens placed near the collimator. In this way the instrument was considerably reduced in length, and thereby its rigidity increased. On Aug. 13, 1904, the sun's limb was under observation, and the definition being very good, two lines were seen in the red part of the spectrum which were determined to be due to calcium, and thus presumably representative of the reversing layer at that point. Their wave-lengths were $\lambda 6439{\cdot}29$ and $\lambda 6494{\cdot}001$. On measuring the lengths of these lines with the slit of the spectroscope tangent to the sun's limb, and also the diam. of the solar image at the same time, it was possible to get a determination of the depth of the reversing layer producing the lines. The quantity thus found was 0·15″, corresponding to 80 or 90 miles depth of the layer. This differs from the value found during eclipses, which has been stated at about 550 miles. C. P. B.

**948.** *Rotation of Jupiter's Satellites I. and II.* **P. Guthnick.** (Astron. Nachr., No. 4000. Nature, 71. p. 469, March 16, 1905.)—From a series of observations of the magnitudes of Jupiter's first and second satellites, made with a Zollner photometer attached to the 11-in. refractor at the Bothkamp Observatory, it was found on plotting the results that the period of the light variations coincided with that of the revolution about Jupiter, and as a consequence the author considers it probable that the periods of revolution and rotation are coincident in each case. C. P. B.

## REFERENCES.

949. *Extensometers.* **J. Morrow** and **E. L. Watkin.** (Phys. Soc., Proc. 19. pp. 365–369 ; Discussion, p. 370, April, 1905. Phil. Mag. 9. pp. 129–134, Jan., 1905.)—An interference apparatus is described by which extensometers may be accurately calibrated. Specimen tests are given. J. W. P.

950. *Impact Testing of Notched Bars.* **G. Charpy.** (Engineer, 99. pp. 249–250, March 10, 1905. Soc. Ing. Civils, France, Mém. 57. pp. 468–482, Oct., 1904.)—Descriptions, with drawings, of a large and a small form of the author's pendulum type of impact machines are given. Experiments show that the effect of the depth of the notch is not as great as the difference between like test bars of the same material. The effect of the velocity of the blow is small, with notches rounded at the bottom. The mode of fracture and other general matters are discussed. F. R.

951. *Resistance to Projectiles.* **A. Mallock.** (Roy. Soc., Proc. 74. pp. 267–270, Dec. 10, 1904.)—Diagrams of experiments on aluminium bullets at velocities up to 4,500 ft. per sec. At the highest velocity the retardation was 205,000 ft./sec.$^2$. A. D.

952. *Sliding Friction.* **P. Painlevé.** (Comptes Rendus, 140. pp. 702–707, March 13, 1905.)—A mathematical consideration of the case of a heterogeneous circular disc rolling on a horizontal plane. Two hypotheses by Lecornu (Ibid. pp. 635–637, March 6) are dealt with, but are considered arbitrary and unverifiable. J. W. P.

953. *Explosive Wave.* **E. Jouguet.** (Comptes Rendus, 140. pp. 711–712, March 13, 1905.)—Calculations by means of a former formula [see Abstract No. 2489 (1904)] seem to show that the mixture of gases at the limit of detonation is that for which the combustion-pressure is equal to the pressure which causes the reaction ; and that the dissociation need not be feeble, as before assumed, for its effect on the speed of the explosive wave to be negligible. R. E. B.

954. *Pressures Developed in a Closed Vessel by Colloidal Powders of Different Shapes.* **R. Liouville.** (Comptes Rendus, 140. pp. 708–710, March 13, and pp. 1089–1091, April 17, 1905.)—Vieille has shown that colloidal powders burn by parallel layers and with a speed of combustion proportional to a power of the pressure, which power in the case of guncotton is about $\frac{2}{3}$. It is difficult to verify this index from ballistic considerations ; but the author compares the relation between pressure and time deduced theoretically on the assumption of this index with the relation as experimentally determined, and finds an exact verification even as to the peculiarities that depend on the shape of the grains. In the second paper calculations are made with the index 1, with less satisfactory agreement. R. E. B.

955. *Some Relations between Direction and Velocity of Movements and Pressure at the Centre of Ellipsoidal Cyclones.* **S. Hanzlik.** (Monthly Weather Rev. 32. pp. 562–565, Dec., 1904.)—Referring to similar researches of Loomis, the author endeavours to trace the relations between the rate of progress and the change of pressure in the centre of the respective lows [see Abstract No. 9 (1905)] and the influence of the azimuth towards which the low moves. He deals with semi-daily maps of the Forecast Division of the U.S. Weather Bureau, selecting cyclones of velocities varying from 50 to 900 miles in 12 hours, and having at least two well-shaped, closed isobars of 0·1 in. difference ; 288 cyclones of the winter seasons, November to March, 1893–1902, are considered. H. B.

**956.** *United States Standards Bureau.* **E. B. Rosa.** (Science, 21. pp. 161–174, Feb. 3, 1905. Address delivered at opening of the John Bell Scott Memorial Lab. of Phys. Science, at Wesleyan University, Middletown, Conn., Dec. 7, 1904.)—An account of the work of the Bureau of Standards of the U.S.A. [See Abstract No. 2121 (1904).] F. E. S.

**957.** *Evaporation Observations in the United States.* **H. H. Kimball.** (Monthly Weather Rev. 32. pp. 556–559, Dec., 1904. Paper read before the 12th National Irrigation Congress at El Paso, Texas, Nov. 16–18, 1904.)—Commenting upon the difficulties of ascertaining the evaporation from different soils, the author refers to G. W. Rafter's statistics on rainfall and run-off, and passes then to evaporation from water surfaces. The empirical evaporation formulæ of Desmond Fitzgerald, L. G. Carpenter, and E. Stelling (St. Petersburg) are of the same type and fairly concordant, while T. Russell's formula differs as to the vapour pressure, and contains no wind-velocity term. The author prefers observations based upon the former formulæ. Carpenter pointed out in 1887 that the temperature of the water in tanks sunk in the ground is lower than that of tanks floating on reservoirs in the vicinity. H. B.

**958.** *Large Sun-spot of February,* 1905. **T. Moreau.** (Comptes Rendus, 140. pp. 487–488, Feb. 20, and pp. 632–635, March 6, 1905.)—Measures are supplied of the dimensions of the great sun-spot as observed at the Observatory of Bourges. On February 2 the length of the spot was 180,200 km., represented by an angular diam. of 252″ of arc, the sun's diam. being 32′ 31·46″. The latitude of the spot varied from —19° to —21°. In the second paper the constitution of solar spots is discussed. C. P. B.

**959.** *Lunar Partial Eclipse, February* 19, 1905. **Puiseux.** (Comptes Rendus, 140. pp. 559–561, Feb. 27, 1905.)—Discussing twelve photographs of the moon taken during the eclipse with the large equatorial Coudé, attention is drawn to the effect of the shadow on the visibility of well-known objects, which are, however, not easily examined usually owing to excessive illumination, and to the detailed investigations of the formations which have recently received special attention with regard to possible evidence of change. C. P. B.

**960.** *Planetary Tides in Solar Atmosphere.* **E. Anceaux.** (Nature, 71. p. 424, March 2, 1905. Bull. Soc. Astronomique de France, Feb., 1905.)—The author examines the evidence as to the possibility of the eleven-yearly period of sun-spot activity being ascribed to the tidal perturbations induced by the combined action of the Earth, Jupiter, Venus, and Mercury. The tides discussed are classified as binary, ternary, cr quaternary, according to the number of planets in action and their aspect. The computed curve arising from the action of Jupiter, Venus, and the Earth agrees very well with the sun-spot curve for the period 1891–1905. C. P. B.

**961.** *Physical Conditions of Planets.* **T. J. J. See.** (Astron. Nachr. No. 3992. Nature, 71. p. 424, March 2, and p. 559, April 13, 1905.)—The author gives a detailed account of a lengthy series of investigations on the internal densities, pressures, and moments of inertia of the more important members of the solar system. C. P. B.

**962.** *Seventh Satellite of Jupiter.* (Nature, 71. p. 449, March 9, 1905. Circular 74 from the Kiel Centralstelle.)—Abstract of a telegram containing a message from Campbell stating that the previously announced discovery of a seventh satellite to Jupiter is confirmed. The object was discovered by Perrine with the Crossley reflector at the Lick Observatory. C. P. B.

## LIGHT.

963. *New Form of Spectrophotometer.* **J. R. Milne.** (Roy. Soc. Edinburgh, Proc. 25. pp. 338–354, 1904–5.)—In a former paper [see Abstract No. 1403 (1904)] a special device was described for bringing the two spectra of a spectrophotometer into juxtaposition, but there was found to be a slight defect owing to the passage of light between the two half-lenses used, thereby necessitating the employment of a special screen to eliminate it. This is avoided in the new instrument, and further modifications are introduced in order to take measurements of light intensities of liquids contained in tubes about 1 m. long. To obtain a small source of light a second slit is placed perpendicular to the primary one, so that the emergent beam from the collimator is sensibly parallel. The difficulty usually found in getting sufficient *width* of spectrum is obviated by using a *cylindrical* lens for the telescope objective. Several additional improvements in the optical train are described. C. P. B.

964. *Juxtapositor for Adjustments in Spectrophotometry.* **J. R. Milne.** (Roy. Soc. Edinburgh, Proc. 25. pp. 355–363, 1904–5.)—In the usual forms of spectrometer the two bands of light whose intensities have to be compared are usually separated by a dark band, and this is considered to seriously influence the accuracy of the estimated matching of the two spectra. The author has devised a specially constructed combination of prisms which eliminate this difficulty. By means of alternate transmissions and reflections from unsilvered or silvered surfaces of these prisms the two beams are sent into the spectrophotometer in exact juxtaposition, and it is carefully designed so that both beams of light are made to pass through equal thickness of glass, thereby avoiding the necessity of any additional correction for length of path. C. P. B.

965. *Bruce Telescope of Yerkes Observatory.* **E. E. Barnard.** (Astrophys. Journ. 21. pp. 35–48, Jan., 1905.)—Details are given of the construction and performance of an important addition to the instrumental equipment of the Yerkes Observatory, a photographic doublet of 10-in. aperture equatorially mounted, with subsidiary companion telescopes of 5 and 6¼-in. aperture clamped to the same framework. As for the work planned with this instrument it is necessary to make long, uninterrupted exposures, the mounting has been so designed as to give a continuous motion across the meridian without reversal of the telescopes. The focal length of the 10-in. lens is only 50 in. (128 cm.), so that it is exceedingly rapid; it gives exquisite definition over a field about 7° in width, and by careful averaging may be made to cover a region of 9°. The plates used are 12 in. square, and the scale of photograph such that 1 in. $=1{\cdot}14^\circ$ or $1^\circ=0{\cdot}88$ in. Guiding is performed with a high-power eyepiece on the 5-in. telescope. For use in southern latitudes reversal gearing is provided in the driving train from the clock. The instrument was taken in Dec., 1904, to Mount Wilson, in South California, where there is being established a branch observatory of the Yerkes institution. It is intended to replace the 6¼ lens by a new one of Jena glass, and an objective prism of the same aperture, for spectroscopic investigation. C. P. B.

**966.** *New Flicker Photometer.* **W. Bechstein.** (Zeitschr. Instrumentenk. 25. pp. 45–48, Feb., 1905. Communication from the optical and mechanical works of F. Schmidt and Haensch.)—The sides of a prism of gypsum, illuminated by the two sources being compared, are brought to focus in turn in the eyepiece by means of a wedge-shaped lens which is rotated in its own plane by a small motor. The instrument is suitable for comparing sources of different colour, and the readings by three observers for two equal paraffin lamps with and without coloured glasses in front of them agree to within 1½ per cent. G. E. A.

**967.** *Quartz Wedge Colorimeter.* **F. Biske.** (Ann. d. Physik, 16. 2. pp. 406–409, Feb. 24, 1905.)—By substituting a quartz wedge for a uniform plate, circular colour dispersion may be increased until it reaches 90° for red and violet, when, if polariser and analyser have their principal planes parallel to the plane of polarisation of the red light, the violet is extinguished. The paper details how, by a measurement of the intensities of the elementary colours seen in the photometer, any observed mixture of colours may be colorimetrically characterised by an instrument constructed on the above principle. G. E. A.

**968.** *Stereoscopic Experiments.* **G. Jäger.** (Akad. Wiss. Wien, Sitz. Ber. 113. 2a. pp. 1353–1360, Nov., 1904. From the theoret.-phys. Inst. der k.k. Wiener Universität.)—Three instruments are described, viz., a polaristereoscope, a concentration stereoscope, and a stereoscopic enlarging apparatus. In the first of these, the pictures of two diapositives are thrown on to a matt glass surface by means of a stereoscopic projecting lantern [see Abstract No. 1944 (1904)], the rays from the projecting lens being passed through two nicols, so that two superimposed images are formed by means of rays polarised at right angles to each other. By looking at the picture through two nicols suitably fixed in a spectacle frame the stereoscopic effect is obtained. In the second apparatus, by aid of the projecting lantern mentioned the two stereoscopic pictures are thrown on to a very large convex lens which focuses them on the observer's eyes, a feeble light being sufficient for illumination in this case. The lens employed by the author was 41·5 cm. diam. In the third apparatus, two stereoscopic images of a solid object are formed by two clear parts of a blackened projection lens, the large lens previously mentioned being again used to focus the image on the observer, it being necessary in this case that the image should be greater than the pupil-distance. G. E. A.

**969.** *Astronomical Seeing.* **J. Halm.** (Roy. Soc. Edinburgh, Proc. 25. pp. 458–462, 1904–1905.)—Following up the reasoning suggested by Langley, that imperfect astronomical seeing was possibly due to a large extent to the formation of atmospheric strata of varying density, which could be improved by proper methods of mixing, the author suggests that probably the best condition to aim for is to choose a station where the atmospheric constants are as nearly adiabatic as possible, so that there is a minimum change in refractivity from one region to another. As the cause of the blurring experienced under poor conditions is most probably due to sudden changes of the index of refraction of the columns of air through which the light from the star or other object is transmitted, and the large scale movements are obviously unavoidable under the varying pressures, the disturbing effect of such will be at a minimum if the temperature and density of the incoming strata are nearest equal to that of those masses they displace. We know from physical considerations that this condition is most nearly approached when the air is agitated by *convection*, and thus the condition imposed artificially by Langley would appear to be the ideal to endeavour to find naturally when choosing a site. It is possible that the excellent seeing usually found on mountain stations may be in consequence of the increased atmospheric agitation produced by the horizontal currents being deflected at the mountain-sides into vertical movements. [See Abstract No. 1172 (1903).] C. P. B.

970. *Measurement of Absorption in Tinted Glasses.* **L. W. Phillips.** (British Optical Journ. 4. pp. 165–168, March 15, 1905. Paper read before the Optical Society.)—The recommendation of the Optical Standards Committee is repeated, viz., that the following is a suitable series of standards for neutral-tinted and coloured glasses:—

| Number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| To transmit light | 80 | 65 | 50 | 40 | 30 | 20 | 10 | 5 | 2·5 | 1·25 per cent., |

and after a short description of the method of measuring absorption, by spectrophotometer, in use at the National Physical Laboratory, instructions are given in the use of a Simmance-Abady flicker photometer for determining the intensity of a source, coloured or white, and hence to standardise a tinted glass. G. E. A.

971. *Absorption of Ultra-violet Rays by Organic Colouring Matters.* **P. Krüss.** (Zeitschr. Phys. Chem. 51. pp. 257–296, March 17, 1905.)—Using essentially the same arrangement as Valenta employed in his later experiments, the author has photographed the ultra-violet spectra of sixty-three dyes or substances that are used in mixing dyes; in some cases the visible spectra were also photographed. The list of bodies examined includes 24 triphenylmethane dyes, 1 diphenylmethane dye, 1 diphenylnaphthylmethane dye, 1 acridine dye, 8 azo dyes, and also such substances as aniline, naphthol, &c. The results, which are given in detail in the original paper in the form of tables, may be briefly summarised as follows: (1) Organic dyes show absorption bands in the ultra-violet, and the number and character of these bands is steady within the dye group. It is therefore possible in many cases to determine by means of a photograph to which class of dyes a particular experimental substance belongs; (2) the colourless bases and dye-components (aniline, $\alpha$-naphthol, $\beta$-naphthol, xylidine, &c.) examined are all "invisibly coloured" bodies with strong absorption bands in the ultra-violet; (3) in the case of many azo dyes the character of the absorption changes when the dyes are dissolved in strong sulphuric acid: we must assume, therefore, that a chemical transformation occurs in the molecule of the dye; (4) the transparency of organic bodies for ultra-violet rays is dependent on the presence and number of double linkages within the molecule; (5) the fastness of organic dyes when exposed to light is certainly dependent on the absorption of ultra-violet rays; nevertheless, it is only in the case of dyes of similar molecular constitution that the absorption can be used as a measure of the fastness of the dye to light. D. H. J.

972. *Double Refraction in Kundt's Mirrors.* **F. Kaempf.** (Ann. d. Physik, 16. 2. pp. 308–333, Feb. 24, 1905. Extracts from the Leipziger Dissertation.

—A metallic mirror of platinum is made by deposition from the kathode of an evacuated tube, and the amount of double refraction is measured. The thickness of the mirror is deduced from observations of the light reflected and absorbed, and the relative retardation of the two rays is measured by a Babinet compensator. This phase difference is about 0·032λ, varying, of course, with the thickness of the mirror. Double refraction can be produced by simple strain; this is probably why it occurs in the case of the mirror deposited from the kathode. R. S. W.

973. *Artificial Double Refraction.* **F. Braun.** (Ann. d. Physik, 16. 2. pp. 278–281, Feb. 24, 1905.)—A description of some attempts to produce double refraction by the stratification of two substances with different refractive indices. Gelatine tablets are left in distilled water until quite soft. A number of rhombs are then cut out and placed in methyl alcohol. If five to eight of these rhombs are placed uniformly on one another and held between two thin glass plates, the dark cross of the biaxial crystal is seen when the preparation is examined between crossed nicols. The preparation, which was 2·8 mm. thick, gave an effect equal to that of a plate of calcspar 0·1 mm. thick. G. E. A.

974. *Relation between Index of Refraction and Density.* **H. Nagaoka.** (Mathematical and Physical Soc., Tokyo, 2. 19. pp. 293–295, 1905.)—The author has previously given an equation connecting refractive index, wavelength, and density. From this it is concluded that the temperature coefficient of index of refraction should be greater than the coefficient of expansion in the case of gases, and the difference is greater for compound than for simple gases. The following results are given in support of this: $\alpha$ is the coefficient of expansion, and $\beta$ the coefficient of refractive index.

| | $\alpha$ | $\beta$ | $\beta - \alpha$ |
|---|---|---|---|
| Hydrogen................. | 0·00366 | 0·00378 | 0·00012 |
| Nitrogen .................. | 0·00367 | 0·00382 | 0·00015 |
| Carbonic Acid............ | 0·00371 | 0·00406 | 0·00035 |
| Sulphurous Acid......... | 0·00390 | 0·00460 | 0·00070 |

S. G. S.

975. *Photographic Impressions with Feeble Illumination.* **C. Gutton.** (Comptes Rendus, 140. pp. 573–575, Feb. 27, 1905.)—With a glow-lamp as source of light, it is found that the impression on a Lumière "blue band" plate is just visible after 1 min. exposure at 660 cm. distance. Other plates are exposed for the same time at distances decreasing to 100 cm. A curve is drawn in which the abscissæ are exposures and the ordinates are calculated from $(I_2 - I_1)/I_2$, where $I_1$ and $I_2$ are the respective photometric amounts of light transmitted by the exposed and unexposed halves of the plate. This curve rises rapidly at first, then more slowly, becoming eventually a straight line. The second curve, determined in an analogous manner, for positives exposed in a frame at 100 cm. distance for 1 min. is almost straight throughout. G. E. A.

976. *Radiation and Electromagnetic Theory.* **R. Hargreaves.** (Phil. Mag. 9. pp. 313–350, March, 1905.)—An analytical treatment and discussion of the following subjects: (1) Radiation formulæ connected with change of period in reflection at a moving surface. Connection with laws of Stefan and

Wien. (2) Refraction. Formula for pressure. (3) Electromagnetic waves viewed from a moving standpoint. Fresnel's formula. Aberration. (4) Reflection and refraction. Application to formulæ in first section. Calculation of pressure. (5) Introduction of charge and current into the equations. Electromagnetic momentum or momentum of radiation.

E. H. B.

977. *Radiation Pressure.* **O. Heaviside.** (Nature, 71. pp. 439–440, March 9, 1905.)—The success of Lebedew and Nichols and Hull in recognising and measuring the pressure of radiation has aroused much interest in the subject which presents at parts rather difficult theoretical aspects. In the first place, if the ether is really absolutely at rest (a difficult idea), the moving force on it has no activity, and its time integral **VDB** can only be called momentum out of compliment. The force becomes active in a moving ether with interesting consequences not now under consideration, the present question being rather how to interpret the pressure of radiation on the assumption of a fixed ether, in the measure of its effects on matter which is either fixed or moving through the ether. Let plane radiation fall flush upon a perfect reflector moving in the same direction at speed $u$. Let the energy density $p = p_1 + p_2$, the incident being $p_1$, the reflected $p_2$. Assume, which seems reasonable at first, that $p_3$, the pressure in the reflector, is zero, then the moving force $p_1 + p_2 - p_3$ reduces to $p_1 + p_2$. Hence—

$$p_1(v - u) - p_2(v + u) = (p_1 + p_2)u, \ldots (1)$$

because the left side is the rate of loss of energy from the waves, and the right side the activity of the force on the reflector. So—

$$p_2/p_1 = (1 - 2u/v)/(1 + 2u/v) = s^2, \text{ say}, \ldots (2)$$

and $s = H_2/H_1$ is the ratio of magnetic forces in the electromagnetic case. Now (2) asserts that the reflected wave gets smaller as the mirror goes faster, and vanishes when $u = \frac{1}{2}v$. Or, if the mirror be pushed against the radiation, the reflected wave gets stronger, and the resisting force stronger until $u = -\frac{1}{2}v$, when it is infinite. The mirror could not be pushed against the radiation faster than $\frac{1}{2}v$. Equation (2) is then regarded as a demonstration that (1) is untrue. It is then shown that the following method is correct. Let radiation fall flush upon the plane surface of a dielectric, which call glass, moving the same way at constant speed $u$, and let the circuital equations in the glass be—

$$-dH/dx = c\dot{E} + \partial I/\partial t, \quad -dE/dx = \dot{B} = u\dot{H}, \ldots (3)$$

*i.e.*, the same as for the ether, with the addition of the electric current of polarisation $\partial I/\partial t$. The reference space is the fixed ether, and $\partial/\partial t$ is the moving time differentiator. Now, if the relation between I and E is such as to permit of an undistorted plane wave, we shall have—

$$\underset{\text{(incident)}}{E_1 = \mu v H_1,} \quad \underset{\text{(reflected)}}{E_2 = -\mu v H_2,} \quad \underset{\text{(transmitted)}}{E_3 = \mu w H_3,} \ldots (4)$$

if $v$ is the speed in the ether, and $w$ the wave speed referred to the ether in the glass. This $w$ is a function of $u$. Also, the boundary conditions $E_1 + E_2 = E_3$, $H_1 + H_2 = H_3, \ldots (5)$ combined with (4), give—

$$H_2/H_1 = (v - w)/(v + w), \quad H_3/H_1 = 2v/(v + w) \ldots (6)$$

An incident pulse of unit depth is stretched to depth $(1 - u/v)^{-1}$ in the act of reflection; the reflected pulse is of depth $(v + u)/(v - u)$, and the transmitted pulse of depth $(w-u)/(v-u)$. The rate of loss of energy from the waves in the process of reflection is—

$$p_1(v-u)-p_2(v+u)-p_3(w-u),\ldots(7)$$

where the $p$'s are the energy densities. But by the above—

$$p_1v=p_2v+p_3w\,;\ldots(8)$$

therefore the rate of loss of energy in $(p_3-p_1-p_2)u,\ldots(9)$ and the moving force on the mirror is $F=p_3-p_1-p_2\ldots(10)$. E. H. B.

**978.** *Polarisation by Metallic Gratings.* **F. Braun.** (Ann. d. Physik, 16. 2. pp. 238–277, Feb. 24, 1905.)—The paper is divided into three parts, dealing respectively with metallic dust gratings [see Abstract No. 1012 (1904)]; microscopic preparations, especially those coloured with gold; and an extension to other preparations. The optical properties of preparations, such as dichroism, are examined, particularly those of gold-coloured fibres of pine-wood in tangential or radial sections, fine coloured drawings being given in illustration. Some of the results obtained are as given below. Each preparation possesses its own colour, and, besides, produces double refraction. Superposed on these there is a Hertz-grating polarisation [see Abstract No. 1638 (1904)], the lines of the grating lying in the vessel walls, to which they are parallel, and being the cause of the complicated phenomena described. Absorption for all wave-lengths takes place in the gratings, heat being evolved. The author has no doubt that the phenomena observed in metal-coloured preparations in transmitted light indicate submicroscopic grating structure. G. E. A.

**979.** *New Triplets in the Arc Spectrum of Strontium.* **A. Fowler.** (Astrophys. Journ. 21. pp. 81–82, Jan., 1905.)—Photographs of the arc spectrum of strontium recently obtained by the writer showed two triplets in the violet which do not appear to have been previously recorded, but it was found on close examination of their respective wave numbers that they had a definite series connection with two of the four narrow triplets described by Kayser and Runge. The wave-lengths of these new groups are—

(*a*) 4087·67, 4071·01, 4061·21; (*b*) 3950·96, 3935·33, 3926·27.

Developing the series formula embodying these lines and the others found by Kayser and Runge, another triplet would be expected in the region near λ6783–6755, but careful examination has quite failed to detect it. In this respect strontium would appear to resemble potassium, in which the first doublet of the second subordinate series is so feeble that it has only been recently detected. [See also Abstract No. 1923 (1904).] C. P. B.

**980.** *Incandescent Spectra of Iodine and Bromine.* **L. Puccianti.** (Accad. Lincei, Atti, 14. pp. 84–89, Jan. 22, 1905.)—Evershed observed a band absorption spectrum and a continuous emission spectrum in the case of bromine and iodine examined in strongly heated glass tubes, and he concluded that we have to do with an emission spectrum for which Kirchhoff's law is not valid. The present author has re-examined the question experimentally, and finds that the vapours of bromine and iodine, when strongly heated, emit luminous radiations which are to be ascribed to temperature alone, and present a *band* emission spectrum that is the inverse of the absorption spectrum. The ocular observation, and still more the photographing, of these spectra requires special care, without which one may easily mistake them for continuous spectra.

D. H. J.

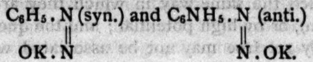
981. *Effect of Pressure on the Ultra-red Absorption Spectrum of Carbon Dioxide.* **C. Schaefer.** (Ann. d. Physik, 16. 1. pp. 93–105, Jan 26, 1905.)—When the pressure on the carbon dioxide is increased, there is a widening of the absorption bands, and at the same time an accentuation of the maximum absorption; neither of these effects can be obtained by merely increasing the thickness of the absorbing layer. Hence it may be concluded that the absorption of carbon dioxide depends not only on the number but on the physical condition of the molecules. The author uses his positive results to criticise adversely Arrhenius' theory of the Ice Age. D. H. J.

982. *New Series in Arc Spectra of Magnesium, Zinc, and Cadmium.* **F. A. Saunders.** (Phys. Rev. 20. pp. 117–118, Feb., 1905. Abstract of paper read before the Amer. Phys. Soc., Dec. 30, 1904.)—From a recent series of photographs of the arc spectra of magnesium, zinc, and calcium, the author has been enabled to recognise several new series of connected lines. In the case of zinc, two series were found (λλ5182, 4299, 3966, 3799) and (λλ6363, 4630, 4114). The lines of the second series are more broadened towards the red, and decrease in intensity more rapidly than the members of the first series. In cadmium there were also found two sets, whose wave-lengths are (5154, 4307, 3982, 3819, 3723) and (6439, 4662, 4141, 3905). On the short wavelength side of four of the members of the first subordinate series of magnesium there are faint triplets of nearly the same separations, which bear much the same relation to the strong series as Lenard's new series in the sodium spectrum bears to the subordinate series of that element. Their wavelengths have not been determined with great precision, but preliminary measurements gave the values (3731, 3051, 2833, 2729) for the first lines of the triplets. A new line was found at λ6319. C. P. B.

983. *Arc Spectra of Fluorides of Alkaline Earths.* **C. Fabry.** (Comptes Rendus, 140. pp. 578–581, Feb. 27, 1905. Journ. de Physique, 4. pp. 245–252, April, 1905.)—The author finds that the fluoride of strontium introduced into the electric arc gives a spectrum similar to that found for the analogous calcium compound, consisting of a series of band heads, which are determined to satisfy the equation $N = A - (Bm + C)^2$, where N is the wave frequency, and $m$ the number of the band from some recognised origin. B and C are constants depending on the origin and scheme of numbering. In each of the series the intensities of the bands decrease gradually from the head. Tables are given showing the values obtained by measures of the spectra of $CaF_2$ and $SF_2$ taken with a large Rowland concave grating of 7 m. radius. The series found are divided into two classes: in (*a*) the constant B is positive, and the bands issuing from each head are degraded towards the red; in (*b*) the constant B is negative, and the bands are degraded towards the violet. Fluoride of barium also gives a good band spectrum, of which the heads only are measurable, and all the series are of the second type where the constant B is less than zero. C. P. B.

984. *Ultra-violet Absorption Spectra of Certain Diazo-compounds in Relation to their Constitution.* **J. J. Dobbie** and **C. K. Tinkler.** (Chem. Soc.,

Journ. 87. pp. 273–280, March, 1905.)—Hantzsch attributed to the isomers of the diazo group the stereoisomeric formulæ—



$$\begin{array}{lcl} C_6H_5.\mathrm{N}\ \text{(syn.) and} & & C_6NH_5.\mathrm{N}\ \text{(anti.)} \\ \quad\quad\;\; \| & & \quad\quad\quad\;\; \| \\ \mathrm{OK.N} & & \quad\quad\quad\;\; \mathrm{N.OK.} \end{array}$$

The present authors have investigated the subject of the constitution of such isomers by the spectroscopic method : Dobbie and Hartley have shown that bodies related like the syn. and anti. compounds show ultra-violet absorption spectra that are identical, or agree more closely than those of isomeric substances which differ in structure. Examples were selected for examination from the following groups: (1) isomeric diazosulphonates; (2) isomeric diazocyanides; (3) isomeric diazotates. The results obtained show that the stable and unstable forms of the isomeric diazosulphonates and of the isomeric diazocyanides give identical or nearly identical spectra; this confirms Hantzsch's view of the nature of these bodies. On the other hand, the isomeric potassium benzene diazotates, as also the two forms of the compound obtained from diazotised sulphanilic acid, give widely different spectra. The spectra of the more stable (Schraube and Schmidt's) potassium benzene diazotate are almost identical with those of phenyl methyl nitrosamine, from which the authors infer that these compounds are constituted alike and are represented respectively by the formulæ $C_6H_5.NK.NO$, and $C_6H_5.N(CH_3).NO$. D. H. J.

985. *Triboluminescence.* **L. A. Tschugaeff.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 36. No. 8. pp. 1245–1253, 1904.)—The author has examined a number of crystalline compounds, and finds that, in addition to the six compounds previously given, benzoyl-β-naphthylamine and benzoyl-*m*-toluidine also exhibit triboluminescence of the first order; with the former this property can be observed in ordinary daylight, and the emission of light may continue for some 6 or 8 sec. The results obtained with a number of amino-compounds show that in many cases of homologues or isomerides, one exhibits triboluminescence whilst the other does not. Similar observations have been made on other classes of compounds. Triphenylmethane is triboluminescent, but its compounds with benzene or thiophen of crystallisation do not exhibit this property; on heating these compounds for a short time above their melting-points and recrystallising the residues from ether or toluene, triboluminescent crystals are again obtained. Aniline hydrochloride exhibits strong triboluminescence, but the basic salt, $2NH_2Ph,HCl$, does not do so. Uranium nitrate completely loses its power of triboluminescence if the crystals are recrystallised from ethereal solution over phosphoric oxide. A number of optically active compounds were examined, and it was found that these exhibit triboluminescence, whilst the corresponding racemic compounds do not. T. H. P.

986. *Distribution of Nuclei.* **C. Barus.** (Amer. Journ. Sci. 19. pp. 175–184, Feb., 1905.)—An account is given of preliminary results with an objective method of showing the distribution of nuclei produced by the Röntgen rays. By causing the rays to pass into one end of a long, tubular condensation chamber, and observing the effect produced after successive different intervals of time by the condensation method, evidence with a possible bearing on the origin of these nuclei was obtained. The coronas are distorted, and at first occur on the bulb side of the apparatus only. The distribution of nuclei is inferred from the form of the corona. The observed

distortion of coronas is due to a gradation of nuclei, either as to size or number, or both. It is suggested that nuclei are produced by the impinging Röntgen rays in much the same way in which they are produced by high temperature (ignition), or by high potential; and the question arises whether the nuclei thus easily set free may not be associated with the electrons to which the cohesions between the molecules may be ascribed. It is found that whenever nucleation and ionisation are associated as the outcome of any process, the former is generally proportional to the latter in such a way that each is produced at its own rate, depending on incidental conditions. The subsequent life-history of the nucleation and ionisation is distinct, nuclei being surprisingly persistent, ions by contrast characteristically fleeting. The author regards the nucleation as the product which owes its growth or origin to the expulsion of the corpuscles representing the concomitant ionisation. Further experiments in continuation of those described in the paper are in progress. J. J. S.

987. *Kunzite and its Unique Properties.* **C. Baskerville** and **G. F. Kunz.** (Amer. Journ. Sci. 18. pp. 25–29, July, 1904. Chem. News, 91. pp. 45–46, Jan. 27, 1905.)—Kunzite does not become luminous by attrition or rubbing, but possesses the property of thermoluminescence with an orange tint and at a low degree of heat. Wollastonite, willemite, and pectolite are, however, very triboluminescent. The mineral assumes a static charge of electricity, like topaz, when rubbed with a woollen cloth. On exposing kunzite crystals of different sizes to the passage of an alternating current obtained from large Helmholtz machines, the entire crystal glowed an orange-pink, temporarily losing the lilac colour. A well-defined brilliant line of light appeared through the centre, apparently in the path of the current. On discontinuing the current, the crystal gave the appearance of a glowing coal. It was not hot, however, and the phosphorescence lasted for 45 min. Ultra-violet rays, produced by sparking a high-voltage current between iron terminals caused kunzite, white, pink, or lilac, to phosphoresce for some minutes; the white responded most readily. All forms of kunzite become strongly phosphorescent under the action of Röntgen rays, though, like all silicates, the mineral is opaque to the rays. An exposure of half a minute caused three cut gems to glow first a golden-pink and then white for 10 min.; the glow was visible through two thicknesses of white paper held over it. After exposure to the rays the crystals gave a very clear picture when laid on a sensitive plate. When acted on for a few min. by radium bromide contained in glass, the mineral becomes wonderfully phosphorescent, the glow continuing persistently after the removal of the source of excitation. The effect is not produced instantaneously, but is cumulative. The emanation from radium, condensed on the crystals by means of liquid air, produced no phosphorescence, and the effect is attributed exclusively to the $\gamma$-rays.

T. M. L.

988. *The Phosphorescence of Phosphorus.* **E. Jungfleisch.** (Comptes Rendus, 140. pp. 444–447, Feb. 13, 1905.)—It is generally believed that the phosphorescence of phosphorus is due to slow combustion, and that it is the vapour of the element which is thus oxidised. The experiments of the author prove, however, that the luminosity is due to the oxidation, not of the phosphorus, but of an oxide of phosphorus resembling in many respects the oxide $P_2O_3$. Thus, when dry carbon dioxide, freed from oxygen by passing over heated copper, is passed over dry phosphorus, there is no phos-

phorescence on the surface of the phosphorus and only a very faint glow where the gas, saturated with phosphorus vapour, passes into the air. This is in accord with the very low vapour tension of phosphorus, which amounts only to 1 mm. of water, or about 0·5 mgm. of phosphorus per litre at 15° C. When a little air was mixed with the gas the phosphorus became only slightly luminous, but there was a very intense luminosity where the gas escaped into the air. The luminosity was much reduced by cooling the gas to —10°, but reappeared on warming to 15°; no luminosity was produced when the gas was passed into a flask filled with inert gas, but it became lumious on pouring into the air. T. M. L.

989. *Radio-active Emanation of Gastein Waters.* **H. Mache.** (Akad. Wiss. Wien, Sitz. Ber. 113. 2a. pp. 1329–1352, Nov., 1904. II. Phys. Inst. der Univ., Wien.)—A much fuller account of the investigation dealt with in Abstract No. 366 (1905), which is now completed. The amount of radio-active emanation in gas from the Grabenbäckerquelle is calculated as being $12 \times 10^{-7}$ mm.$^3$ per litre. The peculiarity of the radium present is that it does not here occur with uranium, and it is not allied with barium sulphate but with an easily soluble barium compound. L. H. W.

990. *Radio-activity of some Fresh-water Springs.* **A. Schmidt.** (Phys. Zeitschr. 6. pp. 34–37, Jan. 15, 1905.)—The examination of certain fresh-water springs of the Taunus revealed a marked radio-activity, which in some cases was much greater than that of the thermal springs. The activity, which is expelled by boiling and appears to be wholly due to an emanation, varies considerably from month to month. The rate of decay of activity corresponds to that of the radium emanation, falling to one-half in four days. T. M. L.

991. *Secondary Radiations.* **P. Lenard.** (Ann. d. Physik, 15. 3. pp. 485–508, Nov., 1904.)—The former papers dealt with the production of secondary radiations; the present with a study of the secondary radiations from a phosphorescent screen. Analogies between secondary radiations and the effects of ultra-violet light; production of kathode rays, these kathode rays being of small velocity from solids; and the rendering gases conductive. Details of experiments. The passage of kathode rays through the atoms of matter results, independently of the state of aggregation of these, in the passage of negative quantities away from these atoms. The velocities of discharge of these are relatively insignificant, and their direction bears no decided relation either to the direction of the exciting rays or to the position of neighbouring surfaces, but the numbers discharged may be very great. [See also Abstract No. 2958 (1904).] A. D.

992. *Secondary Radiation.* **J. A. McClelland.** (Roy. Dublin Soc., Trans. 8. 14. pp. 169–182, March 3, 1905. Phil. Mag. 9. pp. 230–243, Feb., 1905.)—An account of an investigation of the secondary radiation given off by bodies when they are exposed to a strong primary radiation from radium —the $\beta$- and $\gamma$-rays—the nature of this secondary radiation and its relative intensity in the case of different substances being studied. The secondary radiation was detected and measured by its ionising power. When radiation from radium bromide was caused to fall upon a plate in a definite direction controlled by thick lead screens, a secondary radiation which travels in all directions from the part of the plate struck by the primary rays, was detected.

There is a decided maximum in one direction, due probably to a sort of reflection of the impinging particles. The effect is not simply scattering, but a true secondary radiation from the plate. Experiments with a magnetic field show that the secondary rays consist of negatively charged particles. These are not produced merely at the surface of the plate struck by the primary rays, but come from all parts of a layer of considerable depth. In the primary pencil the less penetrating $\beta$-rays are more efficient in producing secondary radiation than the more penetrating. The $\gamma$-rays produce some effect, but a small one. In general, substances of greater density produce the greater secondary radiation when they act as sources, but the secondary radiation is not proportional to the density. The greater the atomic weight the greater the secondary radiation, but the ratio of these two quantities is not constant. Secondary radiation is found to play an important part in many observed phenomena, and it does not differ much in penetrating power from the primary radiation which produces it. (Nature, 71. p. 390, Feb. 23, 1905.)—A note confirming and extending the result obtained above. On testing a large number of elements the rule, that the greater the atomic weight the greater the secondary radiation, is found to hold without an exception. The secondary radiation is not proportional to the atomic weight: it increases less rapidly. J. J. S.

993. *Infection of Laboratories by Radium.* **A. S. Eve.** (Nature, 71. pp. 460–461, March 16, 1905.)—Attempts to make electroscopes having a very small natural leak have been repeatedly unsuccessful in the physics laboratory of the McGill University, Montreal. It has been found that all the materials in the laboratory have become radio-active owing to the presence of radium emanation. About 90 per cent. of the activity can be removed by strong hydrochloric acid. The author recommends that, in laboratories not already infected, any radium should be kept in closed vessels, and none of the emanation discharged except into the outside air. R. S. W.

## REFERENCES.

994. *Cameras for Three-Colour Work.* **W. Gamble.** (Photographic Journ. 45. pp. 150–157, April, 1905.)—A description of the various forms of cameras which have been invented for the purpose of making trichromatic negatives. They are classified according as they use: (1) A repeating back, containing either one long plate or three smaller plates; (2) three separate dark slides, not necessarily on the same plane; (3) one dark slide with three separate plates on one plane, or one plate to receive the three images; or (4) two dark slides, in one of which two plates are exposed together. G. E. A.

995. *Application of Iris Diaphragm in Astronomical Eyepieces.* **Salet.** (Comptes Rendus, 140. pp. 561–562, Feb. 27, 1905.)—An iris diaphragm mounted near the system of cross wires, in front of the field lens of the eyepiece, is found to be extremely useful in altering at will the illumination of the visible field and the cross threads, thereby facilitating observations of feeble objects. C. P. B.

996. *Origin of Radiation and Electromagnetic Inertia.* **P. Langevin.** (Journ. de Physique, 4. pp. 165–183, March, 1905.)—A compact descriptive and mathematical *résumé* of modern theory as to radiation being due to acceleration of charged particles and inertia being of electromagnetic nature. [See also Abstracts Nos. 1411, 1412, and 1416 (1903).] E. H. B.

997. *Radiation through a Foggy Atmosphere.* **A. Schuster.** (Astrophys. Journ. 21. pp. 1–22, Jan., 1905.)—The author discusses the conditions under which "bright-line" or "dark-line" spectra may be produced by a mass of radiating gas, when the scattering by the particles is taken into account, and finds that the spectral characteristics of any original radiation may be very considerably modified by the passage of the light through varying distances of the scattering medium. Suggestions are given showing the bearing of this method of reasoning on the many modifications known to exist in stellar spectra, and the spectra of the solar photosphere, chromosphere, and prominences. C. P. B.

998. *Theory of Radiation in Moving Bodies.* **F. Hasenöhrl.** (Ann. d. Physik, 16. 3. pp. 589–592, March 14, 1905.)—In a recent paper on the above subject the author's remarks were approximate only, through the neglect of a small quantity of the order of $\beta^4$. This was pointed out by M. Abraham, and the necessary changes are here dealt with. [See Abstracts Nos. 2147 and 3219 (1904), and 525 (1905).] E. H. B.

999. *Control of the Development Factor at Various Temperatures.* **W. B. Ferguson** and **B. F. Howard.** (Photographic Journ. 45. pp. 118–123; Discussion, pp. 123–126, March, 1905.)—Experiments are described by means of which, for any given plate and developer, the time of development may be adjusted to the temperature of the developer so as to obtain a constant development factor. G. E. A.

1000. *Revision of Rowland's Standard Wave-lengths.* **L. E. Jewell.** (Astrophys. Journ. 21. pp. 23–34, Jan., 1905. Paper read at the Conference on Solar Research, St. Louis, Sept. 22, 1904.)—Several proposals have recently been put forward for the revision of wave-length standards, and the author suggests that before any radical change is effected the plates taken by Rowland should be remeasured by modern methods, and all fiducial lines rigorously checked by observations with the interferometer and also with concave gratings of larger radius. C. P. B.

1001. *Infra-red Emission Spectra of Metals.* **W. W. Coblentz.** (Phys. Rev. 20. pp. 122–124, Feb., 1905. Abstract of paper read before the Amer. Physical Soc., Dec. 30, 1904.)—The author's investigation deals with the distribution of the emission lines in the infra-red spectrum. It was found that (for the metals examined) there were no lines of measurable intensity beyond the region investigated by Snow. The mercury arc (Aron's lamp) has no important lines beyond 1·3 $\mu$, except in the region of 5 $\mu$, where Drew found a large band for a vacuum tube containing air. D. H. J.

1002. *Fluorescence.* **C. Camichel.** (Comptes Rendus, 140. pp. 139–141, Jan. 16, 1905.)—The author has previously (Ann. Chim. Phys. [7] 5. p. 439, 1895) shown that the absorption coefficient of a body is not altered by transverse illumination, even when the body is fluorescent. Burke has, however, found that the absorption coefficient of uranium glass for the radiations it is capable of emitting is 0·78 when the glass is not fluorescent, and 0·45 when in the fluorescent condition [see Abstract No. 1350 (1899)]. On repeating his previous experiments (*loc. cit.*) on uranium glass, the author finds that the absorption coefficient has the same value in the case when the glass is not fluorescent as when it is. T. H. P.

1003. *Sulphuric Acid and Condensation Nuclei.* **H. Rebenstorff.** (Phys. Zeitschr. 6. pp. 101–106, Feb. 15, 1905.)—A description of the behaviour of sulphuric acid in the formation of fog and condensation nuclei. The author made use of modifications of the apparatus previously employed by him [see Abstract No. 3166 (1904)]. J. J. S.

1004. *Coefficient of Absorption of Light.* **J. Boussinesq.** (Comptes Rendus, 140. pp. 622–624, March 6, 1905.)—An analytical treatment giving a rational formula for the coefficient in the case of any transparent body. J. W. P.

1005. *Symmetrical Optical Objectives.* **S. D. Chalmers.** (Roy. Soc., Proc. 72. pp. 267–272, Oct. 19, 1903, and 74. pp. 396–399, Feb. 24, 1905.)—A mathematical treatment continuing previous work on the theory. J. W. P.

1006. *Radio-active Emanation in Springs.* **A. Gockel.** (Phys. Zeitschr. 5. p. 594, Oct. 1, 1904.)—The author has proved in the usual way that the water obtained from the thermal springs of Tarasp, Leuk, and Baden (Aargau) contains a radio-active emanation. J. J. S.

1007. *Radio-activity.* **W. T. Cooke.** (Nature, 71. p. 176, Dec. 22, 1904.)—A note on a substance obtained on evaporating to dryness a solution from which one or more radio-active precipitates had been obtained. This substance appeared to possess the property of lessening the rate of leak of an electroscope, or was endowed with "anti-activity." J. J. S.

1008. *The Radiation of Hydrogen Peroxide.* **J. Precht** and **C. Otsuki.** (Deutsch. Phys. Gesell., Verh. 7. 2. pp. 53–56, Jan. 30, 1905. Phys. Inst. d. Techn. Hochschule, Hannover, Jan., 1905.)—Referring to the observations of Graetz [see Abstract No. 532 (1905)], the authors describe chemical investigations they have made upon the radiation from $H_2O_2$ and its photographic action. Its power of penetration through various layers of different substances has been observed, and its cutting off by other materials. The observed phenomena are considered to be sufficiently accounted for by the occurrence of vaporisation. **L. Graetz.** (Ibid. 7. 5. pp. 78–86, March 15, 1905.)—Graetz describes and discusses his experiments on the action of $H_2O_2$ [see Abstract No. 532 (1905)] in view of the different conclusions reached by Precht and Otsuki. He considers that the photographic effects observed are not due to vapour from the solution of $H_2O_2$. In some cases the appearances point to the occurrence of a kind of solarisation phenomenon. J. J. S

1009. *Difference between Radio-activity and Chemical Change.* **E. Rutherford.** (Jahrbuch d. Radioaktivität u. Elektronik. 1. pp. 103–127, 1904.)—The radio-active phenomena are considered from the standpoint of the theory of the author and Soddy.

1010. *Radio-activity of the Wiesbaden Thermal Springs.* **F. Henrich.** (Akad. Wiss. Wien, Sitz. Ber. 113. 2b. pp. 1091–1126, Nov., 1904.)—An account of a full investigation by photographic and electrometric means of the gases, water, and mud. The different points will be separately discussed in a later paper.

1011. *Liberation of Heat by Radium Enclosed in a Lead Shell.* **F. Paschen.** (Phys. Zeitschr. 6. p. 97, Feb. 15, 1905.)—The earlier experiments [see Abstract No. 351 (1905)] according to which the heat liberation from 50 mgm. of radium bromide was increased from 3·0 to 5·8 cal. per hour by enclosing in a lead shell, appear to have been subject to large experimental errors. Later experiments under more favourable conditions have given no such marked increase, and it is possible that the absorption of the $\gamma$-rays does not produce the measurable quantity of heat that was indicated by the earlier experiments. T. M. L.

1012. *Are Emanations Electrified?* **A. Battelli** and **F. Maccarrone.** (Phys. Zeitschr. 6. pp. 161–163, March 15, 1905. Phys. Inst. Univ., Pisa. Translation from the Italian.)—Emanations from radio-active substances (radium bromide, Giesel's material) carry no electrical charges, and are therefore probably neither residues of atoms which have lost positive ions nor are they these positive ions themselves. A. D.

# HEAT.

**1013.** *Thermometric Integrator.* **C. Féry.** (Comptes Rendus, 140. pp. 367–368, Feb. 6, 1905.)—A horizontal metal plate is turned uniformly by clockwork, and resting on its surface is a small vertical roller furnished with a horizontal axis in such a manner that the roller may be moved to and fro along a diameter of the other plate. This motion is imparted to the small roller by a metallic thermometer. It is evident that the small roller will turn more or less quickly according to its distance from the centre of the large horizontal disc, and hence this distance, and consequently the temperature determining it, may be inferred from the observed number of revolutions. [A similar principle is employed for the integrating portion of the Parenty water-flow indicator described in Abstract No. 922 (1905.)] C. P. B.

**1014.** *Thermometers for Molecular Weight Determinations.* **E. Beckmann.** (Zeitschr. Phys. Chem. 51. pp. 329–343, March 17, 1905. Communication from the Laborat. f. angew. Chemie d. Univ., Leipzig.)—Describes various modifications of the well-known Beckmann thermometer. Various forms of mercury reservoir are described, which have been designed to facilitate transference of small quantities of mercury when adjusting the scale of the instrument; an important recent improvement is the introduction of a secondary scale attached to the reservoir, indicating the amount of mercury to be left in the reservoir when the zero of the instrument is to be set to any desired temperature. The mode of attachment of the bulb to the tubular stem is discussed, the disadvantage of exposing the upper surface of the bulb to contact with the gases contained in the stem tube being pointed out and overcome by interposing a short piece of solid rod between the bulb and stem-tube; where this is undesirable, a plug of asbestos is used. The advantages of the instrument, and the modes of using it for various purposes, are dealt with in detail. W. Ros.

**1015.** *Change of Volume on Melting.* **A. Hess.** (Phys. Zeitschr. 6, pp. 186–188, March 15, 1905.)—The principle of Archimedes is employed, the substance being contained in a small beaker which is suspended in a liquid bath. The apparatus is described, together with the methods of suspension, heating and determination of temperature. The results for phosphorus are given. The ratio of the specific volumes at the melting-point (44·5° C.) is $0{\cdot}57305/0{\cdot}55399 = 1{\cdot}0344$. S. G. S.

**1016.** *Effect of Magnetisation on the Thermal Conductivity of Nickel.* **G. Schmaltz.** (Ann. d. Physik, 16. 2. pp. 398–405, Feb. 24, 1905. Phys. Inst. d. Hochschule, Stuttgart, July, 1904.)—Employing Röntgen's modification of de Senarmont's method (Pogg. Ann., 1874), a nickel plate measuring 110 × 100 × 5 mm. is heated by means of a steam pipe passing through it, the plate lying on the flat pole-pieces of a Ruhmkorff electromagnet and being suitably protected against loss of heat. The plate, after cooling in ice for 1 or 2 min., takes on a uniform layer of condensed vapour. This evaporates as the heat passes through the plate, and the curves of equal temperature are brought out by sprinkling dry lycopodium on the plate. Assuming that the

radii of the curves are directly proportional to the conductivities along them, it is found that nickel undergoes a total decrease of conductivity of nearly 5 per cent. in an axial direction as compared with the equatorial when in a magnetic field of 1,200 c.g.s. Lafay's contention, that the effect obtained by this method [see Abstract No. 1706 (1904)] is due to convection, is not upheld.
G. E. A.

1017. *Specific Heat of Liquids at Low Temperatures.* **J. J. van Laar.** (Boltzmann Festschrift, pp. 316–325, 1904.)—Additional arguments are brought forward in support of van der Waals' expression $a(bg - b_0)^2 = RT$ for diatomic molecules, where $b_0$ is a constant and $a$ is not variable with temperature. It is shown that the correctness of the assumption for $b_0$, and the necessary consequence that the specific heat should change from 2½ R at the critical, to 6½ R at the freezing temperature, is supported by experiment. The further consequences that the ratio of freezing to critical temperatures is equal to ½ is found very exactly in diatomic substances with the exception of $Cl_2$ and NO. The author considers that the equations of state for fluid substances cannot be applied to the solid state. H. H. F. H.

1018. *Atomic Heat of Solid Elements.* **R. Laemmel.** (Ann. d. Physik, 16. 3. pp. 551–557, March 14, 1905.)—From absolute zero up to their melting-points the isopiestic specific heats of solid elements change by something like 300 per cent. Hence Dulong and Petit's law as to atomic heat requires some qualification, their number, 6·2 being replaceable by any number between 3·5 and 9·5, according to the conditions laid down. It is suggested that the atomic heats of different solid elements may be equal in corresponding states, correspondence being defined by equality of pressure and temperature relatively to their critical values; and at their melting-points (taken as corresponding) the atomic heat is about 9·5. The specific heats of Mn and Li have been determined by the author in the range −80° to 170° C., viz. :—

$$0{\cdot}10722 + 0{\cdot}0_4 78012t - 0{\cdot}0_6 11085t^2 + 0{\cdot}0_9 38178t^3$$
$$0{\cdot}7951 + 0{\cdot}0_2 20632t + 0{\cdot}0_5 25083t^2 + 0{\cdot}0_7 14207t^3$$

respectively, the latter having a point of inflection at about −60° C. R. E. B.

1019. *Temperature Measurements up to* 1,600° *C.* **A. L. Day** and **E. T. Allen.** (Electrochem. Ind., N.Y. 2. pp. 500–501, Dec., 1904.)—Describes the calibration of four thermo-couples of platinum and platinum-rhodium wire at the Reichsanstalt and their transference to the laboratory of the United States Geological Survey at Washington, where they were recalibrated by means of melting-points of metals derived from other sources, good agreement being obtained. For use in determining the melting-points of minerals, a new form of couple and of electric furnace have been designed; the fused minerals being much poorer conductors of heat, and also of much smaller weight than the metallic fusions obtained in the same furnace, it was feared that the thermo-couple, protected in the usual manner, might not follow the small temperature-changes at the melting-point accurately enough; the special form of thermo-couple designed to avoid this difficulty consists of a platinum wire passing down through a fine tube of Berlin porcelain, the platinum-rhodium "wire" taking the form of a broad band wrapped round the outside of the fine porcelain tube, forming a protecting cap; the hot junction is formed at the point where the platinum wire is welded to the cap, and is thus in direct contact with the fusion. The furnace is similar to that used at the Reichsanstalt, but the heating coil is wound on the inside of the cylindrical furnace chamber, while the outside is covered with heat-insulating material. The coil is of 1·5 mm. diam. platinum-iridium wire containing 10 per cent. of iridium; temperatures up to 1,600° C. have been maintained without trouble, but to ensure the greatest steadiness of temperature the furnace must be worked from a storage battery. W. Ros.

1020. *Adiabatics of Vapours.* **T. M. Gardner.** (Frank. Inst., Journ. 159. pp. 199–215, March, 1905.)—Rankine expressed the adiabatics of steam by the formula $pv^n = \text{const.}$, where $n = 10/9$ as an average value. The author, having drawn the adiabatics for steam, $CS_2$, ether, acetone, and $CCl_4$ from the data given in Zeuner's tables, finds that no formula so simple is sufficient to represent them, but that, for the curve of form $pv^n = \text{const.}$, which touches any adiabatic at any point, $n$ decreases with the initial dryness before expansion, and increases as the pressure falls off except with steam of over about 60 per cent. initial dryness, in which case $n$ decreases with the pressure.

R. E. B.

1021. *Van der Waals'* a *in Alcohol and Ether.* **E. H. Hall.** (Boltzmann Festschrift, pp. 899–908, 1904.)—The author has calculated $a'$ from latent heat and specific volumes, and also $a$ from Amagat's expansions and compressibilities. Assuming that the molecular energy is only a function of temperature, it is found that $a$ is a function of both $p$ and T, and increases with increasing $v$ at constant temperature. In alcohol $a$ is smaller than $a'$ at low, and greater at high temperatures. In ether $a$ is somewhat greater than $a'$, and both decrease with rising temperature. [See also Abstract No. 2228 (1904).]

H. H. F. H.

1022. ***Pressure-curves of Univariant Systems Comprising a Gaseous Phase.*** **A. Bouzat.** (Annal. Chim. Phys. 4. pp. 145–195, Feb., 1905.)—Trouton's law has been extended by le Chatelier, Matignon, and de Forcrand to all reversible univariant systems which in vaporising, transforming, or dissociating evolve a gas. If Q = heat absorbed in production of 1 gm.-mol. of gas at temperature T and corresponding pressure P, then $Q/T = \text{constant}$, if the different systems are compared at the same pressure. The author shows, by means of Clapeyron's formula, that this relation leads to the result, $T = AF(p)$, where $p$ is the vaporisation or dissociation pressure of a system at temperature T, and A is a constant peculiar to each system, whilst the function $F(p)$ has the same form for all the systems. From this it follows that if we compare two systems, A and B, at any given pressure, and $T_A$ and $T_B$ are the corresponding equilibrium temperatures, then $T_A/T_B$ will be independent of the pressure chosen. The author shows from a very extensive collection of data that this result holds good within numerous groups, in each of which the reaction occurring is of a similar nature (though not necessarily involving the same substances). It follows that the variation in entropy, corresponding to the liberation at constant temperature and pressure of 1 gm.-mol. of gas, is the same for the different systems belonging to a group when compared at the same pressure. [The foregoing paper indicates an important extension of the useful (though, as Young has shown, only approximate) relation known as Ramsay and Young's law.] F. G. D.

## ELECTRICITY AND MAGNETISM.

### THEORY, ELECTROSTATICS, AND ATMOSPHERIC ELECTRICITY.

**1023.** *Electromagnetic Theory of Spectral Analysis.* **A. Garbasso.** (N. Cimento, 9. pp. 113–150, Feb., 1905.)—In this, the concluding part of the author's work [see Abstracts Nos. 787 and 788 (1905)], he begins by considering the possible structure of a molecule. According to the theorem given in the fourth part (par. 35) the spectrum of any composite body should be formed with slight modifications by superposing the spectra of its elements; but, as he points out, if the elements give lines in the spectrum in the same region overlapping each other, it may be difficult to recognise the spectra of the elements in the spectrum of the compound. And to this he attributes the diversities of opinion that have arisen. He shows that the case treated by Grünwald is included in his own treatment of two conductors with one or two oscillations (pars. 28 and 29). As above stated, the spectrum of the compound is represented in the author's theory, not exactly but with modifications, by superposing the spectra of the elements. He finds in this relation that the periods of the compound are obtained by multiplying by certain constants the periods of the conductors whose oscillations are supposed to give the lines of the spectrum. The existence of fluted spectra and the changes due to heating and to pressure are accounted for by paragraph 35. The theory of paragraph 25 might appear, he says, at first sight to contradict the established fact that bodies chemically isomeric have spectra different not only in the position but in the number of their lines. This contradiction, however, he says, is only apparent, and he gives an explanation referring to his own results. With regard to the possible structure of an atom, two hypotheses are available *a priori*, namely, either that the vibrating body is reduced to a single circuit, or to several distinct conductors. The theory alone, he says, cannot decide which hypothesis is preferable. He subsequently gives reasons for preferring the latter. The problem of constructing a conductor whose spectrum shall have $n$ lines has theoretically $n$ solutions, and this is discussed at length, also the problem of determining from the spectrum the probable nature of the vibrating system. The author's theory is next applied to explain the researches of Lockyer, namely, the long and short lines—referring to Phil. Trans. CLII., 1862—and basic lines treated by Lockyer, also by Kayser (Handbuch der Spectroskopie II. 269E, 1902), also to the dissociation of the elements in the sun (Lockyer, and Kayser and Runge). The behaviour of metals in the electric arc is discussed with reference to Lenard's works, also the positions of lines in different parts of the spectrum. The theory is further applied to the "series of Kayser and Runge," namely, that in the spectra of many bodies there exist series of lines defined by the formula $\lambda_n^{-1} = A + (B/n^2) + (C/n^4)$. It is shown that the conductors investigated in paragraphs 7 and 9 of the present work satisfy this law, and examples are given. Bodies of chemically similar have, as is known, similarly constructed spectra. He supposes, then, that in his theory electrostatic actions and the resistance of the wires are to be neglected, and that the masses of the wires are negligible compared with those of the capacities, from which hypothesis he deduces the results: (1) That if the linear dimensions of a given system are multiplied by a numerical factor $k$, the wave-lengths of the emitted spectrum are multiplied by the same factor; and (2) if, the lengths and relative positions of the wires being unaltered, the capacities are increased in the proportion $1:k$, the wave-lengths should increase in the proportion $1:\sqrt{k}$. In conclusion, he maintains that the series of Kayser and Runge have real existence, that molecules are, subject to certain reservations (par. 88), to be regarded as systems of systems, or at least may be so regarded. That if we start from Lorenz' hypothesis, that what in this treatise are called conducting wires are in reality trajectories of electrons, the results of the author's theory would still be valid. S. H. B.

**1024.** *Drift of Ions by Electromagnetic Disturbances, and Theory of Radioactivity.* **G. W. Walker.** (Roy. Soc., Proc. 74. pp. 414–420, Feb. 24, 1905.) —The author previously showed how the equations of motion of a free ion under the influence of a harmonic train of plane waves might be completely integrated, subject to the restriction that the viscous effect of radiation from the ion may be neglected [see Abstract No. 2585 (1904)]. It is easy to show that while the passage of a complete wave restores the initial velocities of the ion, its position in space is altered. This change of position cannot be accounted for entirely by the change due to velocity which the ion may be assumed to possess before the wave reaches it. The continuance of the waves thus involves the result that the ion must continue to change its position in space. It will thus appear to move in a definite manner which can be determined in terms of the initial circumstances of the ion and the constants of the train of waves. This remarkable result is not confined to an infinite train of harmonic waves. Similar results follow in the case of any form of electromagnetic disturbances propagated in a straight line. The present paper discusses the case of a plane-polarised disturbance propagated in a straight line. The electric force is denoted by $X = X_0 f(Vt - z)$, and the magnetic force at right angles to it $M = (X_0/V) f(Vt - z)$. Then $m$ being the mass and $e$ the charge of the ion, its equations of motions are written: $m\ddot{x} = e(X - \dot{z}M)$, $m\ddot{y} = 0$, $m\ddot{z} = + e\dot{x}M$. Hence, confining attention to the $zx$ plane, we have—

$$\ddot{x} = \frac{e}{m}\frac{X_0}{V}(V - \dot{z}) f(Vt - z), \text{ and } \ddot{z} = \frac{e}{m}\frac{X_0}{V}\dot{x} f(Vt - z).$$

A moving origin is now taken, so that $Vt - z = \zeta$, $\zeta$ being the distance of the ion from a plane moving with the disturbance. The equations then become—

$$\ddot{x} = \frac{e}{m} \cdot \frac{X_0}{V} \cdot \dot{\zeta} f(\zeta), \text{ and } \ddot{\zeta} = - \frac{e}{m} \cdot \frac{X_0}{V} \cdot \dot{x} f(\zeta).$$

Thus, in general, $\dot{x}^2 + \dot{\zeta}^2 =$ constant, is an integral, indicating that the energy of the ion relative to the moving origin is constant. The drifts of the ions are illustrated by diagrams, and special cases are also considered. The conclusion is reached that the propagation of plane-polarised disturbances through a portion of space containing ions involves the drifting of both positive and negative ions, which may be with or against the direction of propagation according to the initial circumstances. Further, since the $z$ motion does not depend on the orientation of the plane of polarisation, similar results must follow for unpolarised disturbances. The significance of this drift in its connection with the radiation of the ion and the theory of Röntgen rays and radioactivity is also discussed. E. H. B.

**1025.** *Atmospheric Electricity on the Sea.* **A. Boltzmann.** (Akad. Wiss. Wien, Sitz. Ber. 113. 2a. pp. 1455–1490, Dec., 1904. Inst. f. theoret. Physik d. Univ., Wien.)—The author crossed the Atlantic by the Hamburg-American liner *Belgravia* in Aug. and Oct., 1904, and made observations on the North Sea and Atlantic with an Ebert aspiration apparatus, an Elster-Geitel dispersion apparatus, and an Assmann aspiration psychrometer. The dust settling on the amber of the Ebert apparatus caused insulation troubles, and the apparatus was modified. The electrometer leaves of both apparatus were sometimes drawn to one side for hours, owing probably to local charges on the ship; the apparatus were mounted on the bridge, where the electric field was very irregular; these points were afterwards investigated in the laboratory and in a balloon. The number of ions and the dispersion did not prove abnormal over the sea. They increased with the temperature or with the sunshine, particularly when intermittent; the dispersion had its maxima at 11 a.m. and 3 p.m. and decreased after sunset, as on land, especially with positive charges; fog also diminished it. The $q = (a - /a +)$ were on the whole high, and decreased with increasing wind to less than 1. H. B.

**1026.** *International Electrical Units.* **F. A. Wolff.** (Inst. Elect. Engin., Journ. 34. pp. 190–207; Discussion, pp. 208–228, Feb., 1905.)—The subject-matter of Wolff's paper [see Abstract No. 173 (1905)] was keenly discussed, **Glazebrook, Webster, Carhart, Harrison, Kennelly, Perry, Wolff, Sharp, Patterson, Duddell,** and **Guthe** taking part in the discussion. The two main points considered were (1) the advisability of displacing the Clark cell by the Weston cell, and (2) whether, as one of the fundamental definitions, the definition of the ampere should be replaced by a definition of the volt. The meeting was unanimous in the opinion that the Weston cell is superior to the Clark cell; and also that the standard of reproducibility of both cells had been considerably increased by the researches of Carhart and Hulett in America, and by Smith, of the National Physical Laboratory. **R. T. Glazebrook** urged, however, that the time was not yet favourable for a change. No one at present can give the e.m.f. of the Weston cell, and probably any new specification based on our present knowledge would not be completely satisfactory. The Institution of Electrical Engineers and the Electrical Standards Committee of the British Assoc. have considered both of these points, and prefer, before displacing the Clark cell, to wait for the conclusion of the experiments at the National Physical Laboratory, and for the completion of the new ampere balance. The congress was favourably disposed to these resolutions. The retention of the definition of the ampere as one of the fundamental units was supported by the British delegates to the congress, but opposed by many of the American delegates. **R. T. Glazebrook** contended that the chemical changes which go on in the silver voltameter are simpler, more readily understood, and more easily controlled than those going on in the cell. Also no distinct practical advantages would follow. On the other hand, **H. S. Carhart** maintained that it is easier to produce concrete standards of e.m.f. than those of current. If the silver voltameter be admitted as a fundamental unit, then the electrochemical equivalent of silver must be determined by means of some ampere balance, and after that the e.m.f. of the standard cell determined by a second step. Since the practical method of measuring currents is by the potentiometer and standard resistances, why not proceed directly to the determination of the e.m.f. of the cell without the intervention of the silver voltameter? The subject of secondary standards and their relation to the absolute units was also discussed. The paper itself should, however, be referred to, as it is not suitable for a brief abstract. [In England the "Weston" cell is regarded as a saturated solution cell at temperatures lower than and at 4° C. The cell saturated at all temperatures, *i.e.*, crystals being always present, is called the cadmium cell. In the paper referred to this latter is spoken of as the Weston standard.] F. E. S.

1027. *Universal Polarisation System for Influence Machines.* **H. Wommelsdorf.** (Phys. Zeitschr. 6. pp. 177–186, March 15, 1905.)—After dealing further [see Abstract No. 174 (1905)] with the question of efficiency of influence machines, and showing that one polarising circuit of the Musaeus machine may with advantage be removed, the author describes a universal polarisation system for influence machines; the older types, and many new ones, may be derived by varying the resistance of different parts, and the angles at which the polarisers and collectors are set. The machine with fixed inducing field, *i.e.*, with single rotating plate, is then dealt with, and improvements on the Holtz form are described. The inductor of low conductivity (paper) is replaced by one of tin-foil with a variable high resistance in series. Also an arrangement of tin-foil discs covered with a continuous layer of paper is described. The author has devised a machine which is self-exciting, and will work under any atmospheric conditions, and in which there is no risk of a change of polarity. [See also Abstract No. 793 (1905).]

S. G. S.

## DISCHARGE AND OSCILLATIONS.

1028. *Investigation of the "Wave-current" Arc.* **C. Heinke.** (Verein zur Beförderung des Gewerbefleisses, Verh. No. 10. pp. 403–428, Dec., 1904.)—The author applies the term "wave-current" to a continuous current, upon which alternations are superimposed. [See Abstracts Nos. 142 and 1304 (1900).] The current in the singing arc is of this character, and the author has studied it by measuring the continuous and alternating components $\bar{J}$ and $\tilde{J}$, the former being given by an ordinary direct-reading ammeter; the latter is calculated from $\overset{w}{J}$, the total or wave current which is measured by a hot-wire instrument, and $\bar{J}$ by means of the relation $\overset{w}{J}^2 = \bar{J}^2 + \tilde{J}^2$. Banti's experiments for the determination of the frequency are criticised on the ground that the nominal values of the capacity and self-induction are used in the calculation, whereas the values under the working conditions should be employed. Using these, the author finds the formula $\sqrt{1/LC}$ to represent the frequency. A number of different types of ammeter, voltmeter, and wattmeter are then examined, with a view to determining their reliability with these high-frequency currents. Four types of ammeter were examined, namely, hot-wire ammeters, soft-iron instruments, dynamometers, and rotating-field instruments. With a hot-wire ammeter, a direct-reading dynamometer of the Allg. Elekt. Gesell. with variable inclination of moving coil, and a dynamometer by Siemens and Halske, all connected in series, and having been previously calibrated with continuous current, the readings are found not to be identical. The hot-wire instrument and the dynamometer of Siemens and Halske are in fair agreement with periodicities up to 100,000, but the A.E.G. instrument gives much too high a reading. It is noted that all direct-reading instruments on the dynamometer principle are useless on high-frequency circuits on account of the variation of the inductance of the main circuit caused by the changing inclination of the moving coil of the instrument. Of the hot-wire instruments, those without shunt are the best, but those with a shunt in the form of a thin sheet are usable ; those having a thick wire shunt are inadmissible. Of the voltmeters, those with coil windings and those of the dynamometer form are useless, since the effective resistance is $\sqrt{R^2 + L^2\omega^2}$, and the latter term becomes important at high frequencies. For reasons given above, the wattmeters of the direct-reading type are useless, but those in which the movable coil is always maintained at right angles to the fixed coil may be employed. The fixed coil is used as shunt in such a manner that only alternating current passes through it, a condenser of large capacity being in series with it ; the instrument, then, only reads the watts due to the symmetrically alternating component of the wave-current, since any continuous current flowing in the moveable coil, and the symmetrical alternating current, will not give rise to any torque. The phase change produced by the volt windings of the wattmeter was great, and of opposite sign to what was expected. This result was found to be due to the capacity of the windings of a non-inductive resistance of 500 ohms which was used in series with the volt winding ; the resistance was acting as a spiral condenser ; its equivalent resistance was determined. Thus, in all measurements an ammeter and an adjustable condenser are placed in series with the fixed coil of the wattmeter, so that this phase change can be varied at will. Numerical results then follow, in which it is shown that under the conditions of the experiment, about half the watts derived from the battery are expended in the shunt circuit, the light from the arc being correspondingly reduced ; also the current $\tilde{J}$ is always displaced in phase towards the e.m.f. $\tilde{E}$, and never in the opposite direction. Experiments are then described dealing with the change in effective resistance of a double-wound coil, due to the capacity of the winding. Next, the relation between the actual and nominal capacities of the condenser in the oscillator circuit is investigated, the actual capacity being taken as $\tilde{J}_c/\omega\tilde{E}_c$. The relation is complicated, and curves for variation of capacity with current and with e.m.f. are given ; the variation of current and e.m.f. from the sine form causes further variation. Finally, the existence of a polarisation e.m.f. in the arc is discussed. The author suggests that the phase displacement of $\tilde{J}$ towards $\tilde{E}$, which occurs when the oscillating current is superimposed upon the continuous current of the arc, may be due to a polarisation capacity in the arc. S. G. S.

**1029.** *Unipolar Conductivity of Hot Gases at Ordinary Pressures.* **A. Byk.** (Phys. Zeitschr. 4. pp. 645–648, Sept. 15, 1903. Inst. f. phys. Chemie d. Univ., Göttingen.)—References to previous work of Guthrie (Phil. Mag. [4] 6. p. 257, 1873), Elster and Geitel (Wied. Ann. 38, 27, 1889), McClelland (Proc. Camb. Phil. Soc., 1900, p. 241, and Abstract No. 1090 (1902)], Richardson [Abstract No. 1091 (1902)] ; in all which the gas was not itself at a uniform temperature. In air at a uniform temperature the unipolar conductivity is markedly independent of the nature of the kathode, and substituting $CO_2$ for air makes no decided difference. Discharge of negative electricity begins at about 520° C. From various methods the author concludes that the conductivity is the result of an ionisation within the gas, not of an electrification at the electrodes. A. D.

1030. *The Arc in a Magnetic Field.* **C. D. Child.** (Phys. Rev. 20. pp. 100–112, Feb., 1905.)—An account of the experiments has been given in a preliminary paper [see Abstract No. 2000 (1904)]. Many results of experiments are given, and the author ends by outlining a possible explanation of the phenomena. It is noticed that when the drop of potential at the anode is small, the effect of the transverse magnetic field disappears; also, with ordinary carbons, the positive discharge from the arc to the surrounding cylinder is greater than the negative, and with salts in the arc it is approximately the same for both, while in a vacuum the negative discharge is the greater and the effect is then zero. Thus, when the drop in potential at the anode is small, the discharge from the arc is large, and the Hall effect disappears. These effects are all explained on the assumption that the velocity of the positive ions is greater than that of the negative ions. [See also Abstract No. 156 (1905).] S. G. S.

1031. *Ionised Air.* **A. Righi.** (Accad. Lincei, Atti, 13. pp. 233–240, Sept. 4, 1904.)—Conditions under which the conductivity is increased by setting the electrodes farther apart, there then being a greater number of ions; and also in which it is affected by a local falling-off in the number of ions on account of progressive absorption of the Becquerel rays which produce them. Attention has to be paid to the position occupied by the electrified bodies relatively to the course and direction of the ionising rays. A. D.

1032. *Apparent Electrolysis in Sparks.* **M. Razeto.** (N. Cimento, 9. pp. 23–31, Jan., 1905.)—The colouration sometimes observed in the portion of an arc or spark towards the negative electrode is not a phenomenon of electrolysis, but is due to the conditions—mainly those of temperature—requisite to enable the lines of the metal-vapour present to become manifest, existing sufficiently towards the negative and insufficiently towards the positive terminal. A. D.

1033. *Relation between Conductivity and Rate of Gas Consumption in Gas Flames.* **F. L. Tufts.** (Phys. Rev. 20. pp. 186–187, March, 1905. Abstract of paper read before the Amer. Physical Soc., Dec. 30, 1904.)—Using platinum electrodes coated with calcium oxide and heated to incandescence by separate electrode flames, the author has measured the conductivity of a connecting flame produced by a burner with a slot 21 cm. long. It was found that small platinum wires introduced into the flame did not alter the total ionisation [compare, however, Abstract No. 1812 (1904)], and so such wires were used, connected to an electrostatic voltmeter, to measure the potential gradient. With uniform connecting-flame height the gradient is uniform. The conductivity of a given cross-section is found to vary directly as the quantity of gas consumed per sec. with the same character of flame. The conductivity of the luminous flame is only two-thirds that of the non-luminous flame. Salt spray introduced imparts greater conductivity to the non-luminous than the luminous flame for the same quantity of salt. With acetylene gas the conductivity of the non-luminous flame is 2½ times that of the luminous flame using the same amount, and over 3 times that of a non-luminous flame using the same amount of coal-gas. The conductivity of hydrogen gas increases much more rapidly than the volume of gas consumed; with 1/10 cub. ft. per min. it is only 3¼ per cent.; with 1/2 cub. ft. per min., over 28 per cent. that of a non-luminous coal-gas flame. L. H. W.

**1034.** *The Potential to Maintain Current in a Gas.* **J. S. Townsend.** (Phil. Mag. 9. pp. 289–299, March, 1905.)—A discussion of theory concerning points raised in the experimental work done in many former papers [see Abstract No. 579 (1905) and before]. From theory it is possible to obtain a criterion to decide whether continuous steady currents are maintained solely or chiefly by the positive and negative ions produced by collision. One striking result, which is in accordance with theory, is that the difference in potential between the electrodes required to maintain a current diminishes as the current increases, provided the pressure of the gas is greater than that corresponding to the minimum sparking potential. Further experimental work is now being done to obtain results which can easily be compared with theory. P. E. S.

**1035.** *Point Discharge in Monatomic and Diatomic Gases.* **P. Ewers.** (Phys. Zeitschr. 6. pp. 133–138, March 1, 1905. Phys. Inst. d. techn. Hochschule, München, Jan., 1905.)—Two thousand samples of the different gases helium, argon, hydrogen, and nitrogen, in a carefully purified condition, have been used in this research. For the methods of purification the paper must be referred to. The voltages between point and plate, and the current passing, are measured simultaneously. The curve showing the relation of the two is called the characteristic of the gas. The results of the observations can be represented by a number of empirical formulæ. The minimum potential required to maintain the discharge in either direction is given by an equation of the type $M_n = C + (M_1 - C)\sqrt{p_n/p_1}$, where $M_n$ is the minimum potential at $p_n$, $M_1$ at $p_1$, and C is a constant. This law holds for a purely point discharge only, and not for one in which negative glow is present. Helium is somewhat exceptional, except at low temperatures. For the positive point discharge a simple law holds, viz., $M\sqrt{L/n} = A$. Here L is the mean free path, M is the minimum potential, $n$ the number of atoms in the molecule, and A is a constant which is practically the same for all four gases under equal conditions of temperature and pressure. The disposable voltage, V, is defined as the excess of the measured voltage over the minimum voltage, and it is found for the monatomic gases that the current is given by the formula $\sqrt{i} = cV + c''$, $c$ and $c''$ being constant under the same conditions. For the diatomic gases the same law holds for low temperatures and pressures, but when these are increased the equation is $i^3 = aV + B$, $a$ and B being constants. It is shown that there is a relation between the constants of the above formulæ, and finally the simple equation $i = \kappa . L . V^2$ is deduced, the letters $i$, L, V having the meanings above and $\kappa$ being a constant. R. S. W.

**1036.** *Action of Radium on the Electric Spark.* **R. S. Willows** and **J. Peck.** (Phys. Soc., Proc. 19. pp. 464–471; Discussion, p. 471, April, 1905. Phil. Mag. 9. pp. 378–384, March, 1905.)—The authors describe some experiments made to elucidate the origin of the ofttimes contradictory effects produced by the action of radio-active substances on the electric spark. [See Sokoltzow, Abstract No. 1132 (1904), and Stefanini and Magri, Abstract No. 1133 (1904).] Two unequal spheres of 27 and 45 mm. diam. were charged by a Wimshurst machine, and 5 mgm. of radium bromide was used (not of highest activity). The effect produced by the radium was found to depend upon the direction of the discharge; with a spark of 2 cm. and the larger ball positive: no effect; with the small ball positive the spark was extinguished by the radium; but the sensitiveness is small at 3 cm. With longer sparks producing a positive brush and a bright pink glow on the kathode the sensitiveness was great; radium at 1 m. distance extinguished the discharge; the sensitiveness appears to increase proportionally up to 12 cm., after which it rapidly increases. Measurements were also made of the current through the gap; it was found that the extinguishing of the spark corresponds with a decrease of current. As regards the effect at different parts of the discharge, the positive end is the most sensitive, probably because the electric field is greatest there. Under reduced pressure the effect of radium was diminished. The action cannot be due to α-rays, since it takes place with the radium enclosed in glass; further, from a comparison of the ionising powers of the Röntgen rays and the rays from radium, it cannot be due to the γ-rays or depend on the ions produced by the ionising agent. Lenard rays were found to have a similar extinguishing action; these also produce a much greater ionisation than the β-rays—it is therefore concluded that it is on the high velocity of the latter that the effect depends. It was further proved by deflecting the β-rays that it is the easily deflectable β portion of the radiation which produces the extinction. L. H. W.

1037. *Discharge through a Gas in Magnetic Field.* **R. S. Willows.** (Phys. Soc., Proc. 19. pp. 453–463, April, 1905. Phil. Mag. 9. pp. 370–378, March, 1905.)—The effect of a transverse field in making the discharge in a tube pass less readily (as compared with the opposite effect of a longitudinal field), but below certain pressures increasing the current and diminishing the difference of potential at the terminals provided it is applied near the kathode [see Abstract No. 1101 (1901)], is due to an action at or near the surface of the kathode, under which the dark space is shortened, say, from 3 cm. to about 2 mm., and is probably not due to a concentration of the luminous portion into a brush or arc, as Almy supposed [see Abstract No. 2145 (1901)]. Longitudinal fields were *not* found to produce any certain decrease in the terminal voltage. The fall in voltage under a transverse field applied near the kathode varies with the strength of the field, at first linearly, then reaching a limiting value, or even, in wider tubes, passing through a maximum. A curve shows the relation between pressure of the gas (diminishing from a few mm.) and terminal voltage; the latter decreases at first linearly, and then less rapidly, when striæ appear at the kathode end of the positive column, and reaches a minimum when the whole length of the positive column is striated; beyond which it rapidly increases. The fall in potential has its chief seat near the kathode; possibly because the negative ions, being made to travel obliquely through the dark space, produce more ions by collision in a region previously poor in ions. A. D.

1038. *Coherence and Decoherence.* **P. E. Shaw** and **C. A. B. Garrett.** (Phys. Soc., Proc. 19. pp. 259–268; Discussion, pp. 268–269, Oct., 1904. Phil. Mag. 8. pp. 165–174, Aug., 1904.)—The authors describe an investigation of these phenomena. Coherence is measured by the force necessary to sunder the surfaces which have cohered. Two forms of apparatus were used—a boom apparatus [see Abstract No. 1313 (1901) and a balance apparatus—both of which are described. The different theories of coherer action are reviewed, and the part played by films on the contact surfaces pointed out. To decide between the rival theories two crucial experiments are detailed. In the first, two surfaces are brought together gently so that the films are not penetrated: no current passes. When a spark is produced coherence occurs, showing that the surfaces are not over $12 \times 10^{-6}$ cm. apart. In the second, having separated the surfaces and cleaned them, on bringing them gently together the current passes readily. On producing a spark coherence is either slight or non-existent. It is thus assumed that a high resistance of the contact is a necessary antecedent condition of coherence. It is concluded either (1) that the film acts as a flux assisting fusion; (2) that ionisation of the film causes attraction of the surfaces; or (3) that there must be some gap (large resistance). This last explanation is found experimentally to be correct; coherence is a solid effect, and occurs even when no film is present, provided there is a gap between the surfaces. The fusion theory is the only one left which is in complete accord with all the facts known. Recoherence is then considered and, like coherence, is found to be a solid effect due to residual coherence; it takes place if the surfaces are at once brought together after separation, but loses this power after a few contacts; it does not take place at all if an interval (30 sec.) elapse after sundering. When recoherence no longer occurs for a direct current, it is found, however, that it often takes place and is renewed once or twice more by reversals. L. H. W.

1039. *Helium Tubes as Indicators for Electric Waves.* **E. Dorn.** (Ann. d. Physik, 16. 4. pp. 784–788, April 11, 1905.)—A Plücker tube filled with helium was found to give such greatly improved results as compared with a selected Warburg tube filled with sodium, used in connection with a Drude wave-length meter [see Abstract No. 839 (1903)] that the subject was investigated. The performance of differently shaped tubes is described, the best results being obtained with cylindrical tubes 20 cm. long and 1·1 cm. diam., provided with one electrode. With this form the strength of the excitation can be gauged by the length of the light column which extends from the place of contact into the cylinder. Tubes filled with neon, krypton, and other gases were compared with the helium tube. Neon was found to be equally sensitive, as also was krypton, but it did not give so bright a light; it is also very expensive. The light from the helium tube is whitish (rose-coloured to grey-lilac). The use of such tubes in the determination of dielectric constants by a modified Winkelmann's method, or Gordon's method, as well as in Nernst's method of comparing capacities, is touched upon and illustrated by an example. L. H. W.

1040. *The Electrolytic Wave-detector.* **B. Macků.** (Phys. Zeitschr. 6. pp. 232–235, April 15, 1905. Phys. Inst. der böhm. techn. Hochschule, Brünn.)—A number of experiments are described which were made with a polariter with an anode produced as described by Reich [see Abstract No. 1756 (1904)]. Some interesting results are obtained by the author, who was able, in very dilute sulphuric acid solution, to observe periodic alterations of current with unaltered applied polarising p.d. These results are fully described, but they admittedly take place in an insensitive region. The effect of an alternating current on the polarisation was then investigated, using 100-volt, 50-∿ current to charge a condenser, the discharge of which was made to affect the polariter. A curve given of the current through the cell with different terminal p.d.'s shows that in the first straight portion (roughly 2 to 3·5 volts) the effect is very small. From about 4·3 to 5·3 volts it is a maximum; it also increases with increase of capacity and increase of concentration. An experiment which is taken to indicate that the effect is accompanied by a diminution of the e.m.f. of polarisation is described. In this a shunt to the polariter, composed of a ballistic galvanometer and a capacity in series, is connected. On opening the main polarising circuit a throw is obtained on the galvanometer. On then causing electric waves to act, the condenser discharges still further, thus showing that the e.m.f. of polarisation at the terminals is diminished, as has been shown by other means by Rothmund and Lessing [see Abstract No. 2971 (1904)]. L. H. W.

## ELECTRICAL PROPERTIES AND INSTRUMENTS.

**1041.** *Dielectric Viscosity of Condensers.* **O. M. Corbino.** (N. Cimento, 9. pp. 81–105, Feb., 1905. Phys. Zeitschr. 6. pp. 138–142, March 1, 1905. Écl. Électr. 43. pp. 227–230, May 13, 1905.)—The retardation in phase of the charge on the plates of a condenser behind the e.m.f. when the latter is alternating and of high frequency is experimentally determined. The alternating e.m.f. is produced by the singing arc and is sinusoidal in form. [See Abstract No. 2664 (1904).] The condenser to be examined is placed with an inductance (A) in series with it, as shunt across the inductance of the Duddell circuit, and an inductance (B) is placed as shunt across this same condenser. The inductance coils A and B are arranged so as to act simultaneously on a Braun's tube, the displacements due to the two being at right angles and giving two rectangular co-ordinates. The motion of the fluorescent spot is in general elliptical, and it is shown that the lag of the charge on the condenser behind the p.d. can be calculated from the ratio of the axes of the ellipse and the inclination of its major axis to the axis of co-ordinates, the resistance and inductance of B being known. For a paraffin paper condenser the retardation is found to be 2° 10′ with a frequency of 3,640 oscillations per sec., and 3° with a frequency of 1,900. The theories of Hess [Journ. d. Phys. 3. 1. p. 459, 1892], Pellat [see Abstracts Nos. 1158 and 1159 (1899)], and Maccarrone [see Abstract 825 (1903)] are then examined in the light of these results, and it is found that the last two are not in accordance with them, but a modification of the first is capable of representing the results with considerable accuracy. According to Hess, the dielectric, which is looked upon as a perfect insulator, throughout which conducting particles are distributed, may be imitated by two condensers in series, one of which is shunted by a resistance. On calculating the value of this resistance from the capacities as deduced from the author's experiment, it is found to be inadmissibly low. If, however, three capacities in series are taken, two of which are shunted by resistances, values for the capacities and resistances are found which represent the result of the experiment very closely. S. G. S.

**1042.** *Effect of Pressure on the Electrical Resistance of Selenium Cells.* **F. C. Brown.** (Phys. Rev. 20. pp. 185–186, March, 1905. Abstract of paper read before the Amer. Physical Soc., Feb. 25, 1905.)—The author has investigated the effect on the conductivity of selenium cells, of pressures up to 600 atmospheres. The cells were made after Bidwell's method, and the hydraulic pressure was applied by a Cailletet pump, the cell being kept in an ice-packed receiver and allowed to reach the ice temperature between changes of pressure. The following table shows the almost uniform decrease of resistance with increase of pressure :—

| Pressure kg./cm$^2$. | Resistance, ohms. | Pressure kg./cm$^2$. | Resistance, ohms. |
|---|---|---|---|
| 0 | 96,000 | 100 | 79,790 |
| 30 | 91,150 | 120 | 76,980 |
| 50 | 87,800 | 150 | 72,510 |
| 70 | 84,400 | 218 | 63,900 |

L. H. W.

**1043.** *Calibration of Wave-length Meters, especially the Slaby Multiplying Rod.* **P. Drude.** (Elektrotechn. Zeitschr. 26. pp. 339–342, April 13, 1905.)—The author describes two methods of calibrating the multiplying rod form of wave-length meter dealt with in Abstract No. 213B (1904). As a preliminary it is pointed out that the instrument can be excited by magnetic coupling in place of electrical coupling as recommended by Slaby. This may be effected by holding the rod, perpendicular to the antenna, in proximity to the transmitter at a point where the current is large, and placing the metal point near the antenna, and not the point of the rod itself; or in coupled systems by putting the metal point in the interior where the magnetic lines of force due to the oscillatory circuit are. This prevents increase of capacity due to the rod's proximity; the current loop is also more get-at-able than the potential loop. The first method described (direct method) utilises an aluminium plate condenser in a petroleum bath, one plate being movable by a micrometer attachment. Attached to the condenser plates may be one pair of a number of symmetrical semicircular strips or windings, each (in a single turn) ending in a zinc knob, between which the spark takes place. A short Lecher system is brought into resonance with the exciter (magnetic coupling) by altering the distance between the condenser plates and observing the effect on a vacuum tube or tube filled with helium. The rod to be calibrated is then substituted and brought into resonance. This method is convenient for wave-lengths up to 16 m.; for longer wave-lengths the Lecher system is doubled back on itself (making two right-angled turns). The indirect method is one which has previously been described [see Abstract No. 839 (1903)], and is applicable to waves of lengths such as are used in wireless telegraphy. This is then fully dealt with. The results of a number of calibrations is given; the correction is always positive owing to Slaby's having assumed that $\lambda = 2l$, while $\lambda$ is always $> 2l$. The corrections are, however, small. L. H. W.

**1044.** *Self-decohering Wave-detector.* **P. Lohberg.** (Mechaniker, 12. pp. 234–235, Oct. 20, 1904.)—The author describes a detector which he considers resembles Fessenden's barretter. One or more gramophone needles are fastened to a metal plate, enclosed in an ebonite box, the plate being made kathode, whilst the anode consists of another plate which is covered with a fine piece of silk. The silk is soaked in glycerine, so that small bubbles are in the meshes of the silk, and the needle-point is pressed up against the anode (by a micrometer screw) through the silk, and then withdrawn. A small current is passed through the cell, and the arrival of electric waves causes an interruption of this current; the current is restored on the waves ceasing. No explanation is given by the author, but the detector is classed with the anticoherers, amongst which the author curiously includes the Fessenden barretter. L. H. W.

**1045.** *High-resistance Potentiometer.* **W. Schüppel.** (Elektrotechn. Zeitschr. 25. pp. 849–852, Sept. 29, 1904.)—The arrangement of the potentiometer or compensator due to Thiermann, for obtaining the greatest accuracy and range, is here described in detail. The main portion consists of a Thomson-Varley bridge, consisting of 12 coils of 2,000 ohms each and eleven coils of each of the following values: 400, 80, 16, 3·2, and 0·64 ohms; the whole being equivalent to a "slide-wire" of 22,000 ohms divisible to $\frac{1}{50}$ ohm. It is suitable for use as a Wheatstone bridge, even for the comparison of low resistances if a double balance be taken. For potentiometric work a second "slide-wire" of 22,000 ohms is added in parallel with the first, the contact on which is capable of adjustment merely between the ranges 20,366 and 20,394 ohms, which correspond to the range of voltage 1·0183 to 1·0197 of the Weston cell. The movement of a single throw-over key permits of immediate standardisation as often as required. The potentiometer is provided with a convenient voltage regulator. This consists of a switch by which the full potentiometer reading to six figures (without interpolation) can be obtained for any voltage ranging by powers of 10 from 1,000 volts down to $\frac{1}{1000}$ volt, provided always that a galvanometer suitable to the work is available. For the higher voltage a divided resistance is employed, and for the lower a multiplier, similar to that of Franke [see Abstract No. 80B (1904)], but so constructed that a single operation serves by means of shunts and series resistances to reduce the rate of fall of potential in this "slide-wire" in a definite ratio. An Ayrton-Mather galvanometer shunt is used in conjunction with series resistances. D. K. M.

## ALTERNATING CURRENTS AND MAGNETISM.

1046. *Magnetic Change of Resistance of Iron and Nickel at Various Temperatures.* **W. E. Williams.** (Phil. Mag. 9. pp. 77–85, Jan., 1905.)—Knott had previously measured the change of resistance in nickel at temperatures up to 400° C. for fields up to 34 c.g.s. units [see Abstract No. 1159 (1904)]. The writer has also determined for iron and nickel the changes at temperatures up to 100° C. for fields up to 800 units [see Abstract No. 485 (1903)]. The object of the present paper was to continue the experiments up to a temperature of 665° C. (thus including the critical point for nickel), and with fields varying as far as 900 units. The wires under test were heated inside a hard glass tube containing also a platinum thermometer. On the outside of the tube was a heating coil of platinoid wire and a magnetising coil consisting of 8 layers of No. 14 copper wire, giving a field of 40 units per ampere. The charges of resistance of the iron and nickel wires were measured by a slide-wire bridge. The following results were obtained: *Nickel.*—As the temperature increases the change of resistance diminishes, the rate of diminution being greater at high fields. The decrease reaches a maximum at 340° C., and finally vanishes at 380° C. *Iron.*—The results are similar to those for nickel, but there is a marked increase for the temperature 580° C. *Nickel-steel.*—For longitudinal magnetisation the change of resistance reaches a limiting value at a field of about 300 and then remains constant; for transverse magnetisation most of the specimens showed an increase in resistance at low fields and a diminution at high fields.
E. S. A. R.

1047. *Hertzian Waves and the Magnetisation of Steel.* **C. Garibaldi.** (Atti dell' Assoc. Elettr. Ital. 9. pp. 23–28, Jan.–Feb., 1905.)—The results of different observers, as to whether Hertzian waves increase or diminish the work of hysteresis, are in disaccord. [See the literature collected by Arnò, Abstracts Nos. 1156 (1904) and 1058 (1905).] The author gives a wide range of experimentally observed conditions under which the apparent result was sometimes the one way, sometimes the other, and which may help to explain the disaccord referred to. He finds that steel in the neutral state is not affected by Hertzian waves; that these acting on residual magnetism produce a decrease of flux; that if the material be magnetised in a determinate sense, under conditions of increasing magnetisation, the Hertzian waves increase the flux; that these reinforce the effect of a demagnetising field, and that the sensibility of this is greatest as the demagnetisation reaches completeness; that a body, rendered insensitive to the waves while subject to a demagnetising field, regains sensitiveness when this field is off, but the residual magnetism increases. **M. Ascoli** (Ibid. pp. 29–35). Ascoli shows that all these results, and, indeed, the whole matter, may be explained by taking into account the effect of the waning alternating field due to the current induced in the circuit by the Hertzian waves themselves and the superposition of this field upon that due to the magnetomotive forces applied. The effect of this brief superposed field will depend on the particular part of the hysteretic cycle at which the Hertzian waves impinge; and the manner in which it will do so Ascoli traces out by means of numerous diagrams.

A. D.

**1048.** *Magnetic Bodies in Rotatory Field under Induction of Alternating or Interrupted Currents.* **R. Arnò.** (Elettricista, Rome, 4. p. 70, March 1, and pp. 133–134, May 1, 1905. Accad. Lincei, Atti, 14. pp. 278–281, March 5, 1905.)—A hollow cylinder of steel, in a weak rotatory field, manifests, when an alternating or interrupted current is passed round it coaxially, an increase in the lag with which the magnetisation of the cylinder follows the rotation of the field; and this increase is greater the greater the strength and the frequency of the alternating or interrupted current, and is also greater the greater the number of turns of the wire bearing that current. In stronger fields such as those used by Ewing and Walter in their first experiments [see Abstract No. 857 (1904)], the author now confirms the results of these experimenters—that there is not an increase but a decrease in the lag—which he had prievously disputed [see Abstract No. 1156 (1904)]. Between these two, there is a critical value of the rotatory field at which Hertzian waves produce no change in the lag. A. D.

**1049.** *Ballistic Magnetic Testing.* **A. F. Ganz.** (Science, 21. pp. 335–336, March 3, 1905.)—An ordinary Weston ammeter without its shunt was used for determining permeability and hysteresis curves by the ballistic method, and the curves were compared with those obtained by means of a slow-period undamped ballistic galvanometer. It was found that the curves for a laminated iron ring, obtained with an ordinary Weston instrument fell about 3 per cent. below those obtained with the ballistic galvanometer, and a difference of 10 per cent. resulted when a solid iron ring was employed. The cause of this difference is undoubtedly that the time of the first swing of the ordinary Weston instrument is too short to take account of all the changes in the magnetic flux. The Weston Co. therefore constructed a special instrument having a greater moment of inertia and more magnetic damping than their ordinary instruments, and this was found to give a permeability curve for the laminated ring which agreed exactly with the curve obtained with the ballistic galvanometer. For the solid ring, however, the permeability curve was still several per cent. low, and the Weston Co. are therefore constructing a second special instrument having a still lower period. It is anticipated that these instruments will be generally useful for all kinds of magnetic testing. F. E. S.

**1050.** *On the Alloys of Heusler.* **E. Gumlich.** (Elektrotechn. Zeitschr. 26. pp. 203–207, March 2, 1905. Ann. d. Physik, 16. 3. pp. 535–550, March 14, 1905. Communication from the Physikal Techn. Reichsanstalt.)—Two alloys are used having ingredients and percentages thus: (1) Cu 61·5, Mn 23·5, Al 15, Pb 0·1. (2) Cu 67·7, Mn 20·5, Al 10·7, Pb 1·2. Such alloys have remarkably high permeability, as has been shown by Heusler, Starck, and Haupt [see Abstract No. 623 (1904)]. The present inquiry is on their properties when kept for long periods at constant temperatures from + 165° to — 190° C., in some cases for as much as 540 hours. From the results of B and H, values are obtained of (1) the coercive power, (2) the permeability, (3) the loss of energy per cub. cm. (E), and (4) the Steinmetz hysteresis coefficient ($\eta$) which is given by the expression $E = \eta . B^{1\cdot6}$. It is found that permeability rises as heating at 110° is prolonged, but that heating to 165° lowers the permeability again. The greatest value of $\eta$ is obtained when the temperature is at the highest point, + 165°. When the temperature is maintained at — 190° for as much as 10 hours, no change seems to be produced. [See also Abstracts Nos. 622 and 623 (1904).] P. E. S.

**1051.** *Hysteresis Loss as Depending on Frequency.* **T. R. Lyle.** (Phys. Soc., Proc. 19. pp. 370–394; Discussion, pp. 394–398, April, 1905. Phil. Mag. 9. pp. 102–124, Jan., 1905.)—By means of his wave-tracer and harmonic analyser [see Abstract No. 75B (1904)] the author has carried out a series of investigations on the variation of the hysteresis loss with frequency. Two rings of laminated annealed iron were used, in one of which the radial depth of the iron was considerable in comparison with the diameter of the ring. The total iron loss was determined for various frequencies. From this loss was subtracted the "statical" hysteresis loss obtained by Ewing and Klaasen's method, and the eddy-current loss, which was calculated. The remainder so obtained was considerable, and represented the increase of hysteresis loss due to increase of frequency. A. H.

**1052.** *Diamagnetism of Bismuth.* **A. Leduc.** (Comptes Rendus, 140. pp. 1022–1023, April 10, 1905.)—The author calls attention to an experiment made by him in 1886, in which he obtained spheres of bismuth by filling hollow glass spheres, 2 cm. diam., with the molten metal. The bismuth is allowed to solidify in a strong magnetic field (4,000–to 5,000 c.g.s.). Each sphere after solidification will, when suspended in the field, orient itself in the direction it occupied during solidification. If the sphere be rotated and the field then applied, the sphere will stop in a position in which its direction of maximum permeability is the same as that of the field. It is considered probable that magnetite, pyrrotite, or other magnetic or diamagnetic substances would, when treated similarly, show the same behaviour.

L. H. W.

## REFERENCES.

**1053.** *Calculation of Retarded Potential.* **G. Herglotz.** (Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse, 6. pp. 549–556, 1904.)—A mathematical discussion of the problems of electron theory, and especially of the new and simpler methods of Sommerfeld for the field of an electron [see Abstract No. 574 (1905)].

E. H. B.

**1054.** *Equilibrium of a Liquid with its Vapour in a Magnetic Field.* **S. Sano.** (Mathematical and Physical Soc., Tokyo, 2. 18. pp. 265–276, 1904.)—A highly mathematical paper discussing the equilibrium of a pure liquid with its vapour in a magnetic field, the surface tension being neglected and the changes all supposed reversible, *i.e.*, hysteresis and time-lag excluded. [See Abstract No. 596 (1905).]

E. H. B.

1055. *Magnetostriction.* **F. Koláček.** (Phys. Zeitschr. 6. pp. 143–147, March 1, 1905.)—A mathematical and critical discussion of the article on magnetostriction by S. Sano [see Abstract No. 190 (1905)]. E. H. B.

1056. *Magnetic Analogue of Movement of a Dielectric in an Electric Field.* **A. H. Bucherer** and **A. Pflüger.** (Phys. Zeitschr. 4. pp. 616–617, Sept. 1, 1903. Physik. Inst. d. Univ., Bonn.)—Endeavours to obtain an e.m.f. induced by moving a para- or dia-magnetic substance in a magnetic field, analogous to the magnetic force developed (Röntgen, Pender, Eichenwald) by moving a dielectric in an electric field. Results thus far are negative. A. D.

1057. *Condensation by Air Ionised by Röntgen Rays.* **J. Campanile** and **G. di Ciommo.** (Phys. Zeitschr. 4. pp. 648–653, Sept. 15, 1903.)—Air traversed by Röntgen rays condenses a sensitive jet of vapour of other liquids besides that of water ; and it condenses the vapours which arise above liquids exposed to the air in a charged metallic dish. Negative ions are more active than positive. A. D.

1058. *Hertzian Wave-detector with Ferraris Field.* **R. Arnò.** (Atti dell' Assoc. Elettr. Ital. 8. pp. 354–357 ; Discussion, pp. 357–359, July–Aug., 1904.)—A slightly modified form of the detector [see Abstract No. 1156 (1904)] is described, and the experimental determination of the best length of winding, already described by Colabich, referred to [see Abstract No. 2970 (1904)].

1059. *Multiple-pole Electric Machine.* **H. Wommelsdorf.** (Ann. d. Physik, 16. 2. pp. 334–349, Feb. 24, 1905.)—A continuation of the work appearing in Abstract No. 793 (1905). The advantages of having several poles for the production of high voltages are pointed out. R. S. W.

1060. *Mercury Voltameters and the Wright Electrolytic Supply Meter.* **H. Danneel.** (Zeitschr. Elektrochem. 11. pp. 139–145, March 10, 1905.)—Describes the form of Wright electrolytic meter [see Abstract No. 775 (1902)] made by Lux. Tests by the Reichsanstalt and by the author show that the meter is reliable, even for small laboratory currents and with moderate overloads. H. B.

1061. *Controlling Actions at a Distance by Means of Electric Waves.* **E. Branly.** (Comptes Rendus, 140. pp. 777–779, March 20, 1905.)—A selective mechanism of the rotating-disc type is outlined, with the tripod coherer as wave-sensitive device.

1062. *Stefan's Theory of Strong Magnetic Fields.* **B. Walter.** (Ann. d. Physik, 14. 1. pp. 106–117, May, 1904.)—A critical discussion of Stefan's formulæ for the strength of the field between two equal flat poles or between two conical poles. The formulæ are justified with conical pole-pieces (reducing the section to less than one-tenth) when the distance between the poles is very small (½ mm.), but the strength very rapidly decreases as the distance between the poles increases, and it falls short of the theoretical value ; but with cylindrical poles it is not possible even with the strongest currents to get the iron completely saturated as the theory requires, and this possibility recedes still farther as the distance between the poles is increased. A. D.

1063. *Physical Decomposition of the Earth's Permanent Magnetic Field.* Parts 3 and 4. **L. A. Bauer.** (Terrestrial Magnetism, 8. pp. 97–129, Sept., 1903, and 9. pp. 113–133, Sept., 1904.)—A continuation of the author's previous work [see Abstract No. 1946 (1901)], in sections dealing with (1) The earth's total magnetic energy, (2) Seat of the cause of secular variation, (3) Improvement of the Gaussian theory, (4) Secular motion of free magnetic needle, (5) Vertical earth-air electric currents, and (6) Residual magnetic field and diurnal variation field.

## CHEMICAL PHYSICS AND ELECTRO-CHEMISTRY.

1064. *Notion of Valency.* **R. Abegg** and **F. W. Hinrichsen.** (Zeitschr. Anorg. Chem. 43. 1. pp. 122–124, Jan. 16, 1905.)—Billitzer [see Abstract No. 418 (1905)] is of opinion that the valency of an element is a function of the temperature. But this notion falls to the ground when valency is sharply distinguished from affinity. Thus phosphorus pentachloride partly decomposes at high temperatures into phosphorus trichloride and chlorine; but phosphorus pentafluoride remains stable at these temperatures, so that the 5 valencies of the phosphorus must be still present. The substitution value of any element does, indeed, depend on the temperature and pressure, but this is no argument against a constant maximum valency. For when the temperature falls the valency increases only to a limiting value. According to the authors' views, the idea of valency cannot exist without the atomic theory. T. H. P.

1065. *Molecular Weight Determinations with Platinum Thermometers.* **H. T. Barnes, E. H. Archibald,** and **D. McIntosh.** (Amer. Chem. Soc., Journ. 27. pp. 47–49, Jan., 1905.)—In the determination of molecular weights by the boiling-point method, the Beckmann thermometer may be conveniently replaced by a platinum resistance thermometer. The method used by the authors is a differential one, two thermometers of exactly the same resistance, and each consisting of about 1 m. of 6-mil wire wound on a mica frame, being placed together with their compensating leads in two tubes closed at their lower ends and sealed into larger tubes. The latter contain glass beads, to prevent bumping, and are filled with the solvent to the same height, the amount of solvent in one being carefully weighed; both are fitted with side-condensers. The tubes are heated in an air- or oil-bath until the liquid boils freely, when the zero point of the bridge is found. A weighed amount of substance is then introduced into the weighed amount of solvent and the zero point again ascertained. The molecular weight is then calculated in the usual manner. T. H. P.

1066. *Molecular Weights of Radium and Thorium Emanations.* **W. Makower.** (Phil. Mag. 9. pp. 56–77, Jan., 1905.)—The rate of diffusion of the radium emanation through a plug of plaster of Paris was compared with that of oxygen, carbon dioxide, and sulphur dioxide. If Graham's law of diffusion were strictly applicable, the value of $\lambda\sqrt{M}$ should be constant, whatever gas is employed. This is not the case, since $\lambda\sqrt{M}$ decreases as $\lambda$ decreases in the three gases of known molecular weight. There is, however, a linear relation between these quantities, and it is therefore possible to calculate the molecular weight of the emanation from its observed coefficient of diffusion. On this basis of calculation three experiments gave for the molecular weight the values 85·5, 97, and 99. On the assumption that the emanation is a monatomic gas, it probably occupies the vacancy in the periodic table in the fluorine group between Mo (96·0) and Ru (102). As this is the first vacancy in the periodic table, it is impossible to assign a place in the periodic table to the emanation on the assumption that it is polyatomic; the present experiments, therefore, confirm the view that the emanation is monatomic. The diffusion coefficient of the thorium emanation could not be determined by the method employed for the radium emanation on account of the much greater rate of decay of radio-activity. A comparative experiment showed, however, that the thorium emanation diffuses a little more slowly than the radium emanation, the ratio of the two coefficients being $\lambda'/\lambda = 0·931$, thus confirming the statement of Rutherford that the two emanations do not differ much from one another in molecular weight.

T. M. L.

1067. *Method of Calculating Atomic Weights.* **J. Meyer.** (Zeitschr. Anorg. Chem. 43. 2. pp. 242–250, Jan. 25, 1905. Chem. Inst. d. Univ., Breslau.)—Suppose the constant quantity $a$ is to be determined from a series of equations of the form $a = \frac{m}{u}$, where $m$ and $u$ denote masses of chemical substances. The author, following Ostwald, assigns to each determination of $a$ a "weight" proportional to the mass of substance employed, and therefore writes $a\Sigma m = \Sigma am$, whence $a = \Sigma am/\Sigma m = \Sigma(m^2/u)/\Sigma m$. He gives several examples of atomic weights recalculated by him on this plan, and discusses other methods of obtaining the most probable values from a series of determinations.

F. G. D.

1068. *Determination of Molecular Weight by Lowering of Vapour Pressure.* **E. P. Perman.** (Chem. Soc., Journ. 87. pp. 194–198, Feb., 1905.)—The solution is heated in the vapour of the pure solvent, boiling under atmospheric pressure, in a U-tube, 4·5 mm. diam., each arm of which is 7 cm. long. This is connected on one side with a vertical tube about 23 cm. long and 1·3 mm. diam., and on the other with a short tube 6 cm. in length and 14 mm. diam., having a small bulb blown in the centre, while the long tube terminates in a "diagonal" stop-cock of 0·5 mm. bore. Full details are given of the manipulation, which requires great care, and the lowering of vapour pressure $d$ is read directly. Then $m$, the required molecular weight, is given by $m = w\mathrm{M}p/\mathrm{W}d$ where M is the molecular weight of the solvent, $w$ the weight (in gm.) of the substance taken, W the weight of the solvent, and $p$ the height of the barometer. Determinations with water, chloroform, and ether as solvents have given results equal to those obtained by the boiling-point method.

W. H. Si.

1069. *Electrical Conductivity of Colloidal Solutions.* **G. Malfitano.** (Comptes Rendus, 139. pp. 1221–1223, Dec. 26, 1904.)—Filtration of colloidal solutions of ferric chloride, arsenic pentasulphide, and white of egg through a collodion membrane is found to separate the colloid granules from the rest of the solution without affecting any dissolved electrolyte. Determinations of the conductivities of these solutions before and after filtration show that, although the concentration of the colloidal granules is considerably increased in the liquid remaining on the filter, no rise in the conductivity of this liquid occurs, so that no appreciable electric charge can be carried by the granules. It is concluded, therefore, that the electrical conductivity of all colloid solutions is probably due to the invariable presence of small quantities of electrolytes.

W. H. Si.

1070. *Constitution of Sodium Salts of some Acids containing a Methylene or Methinene Grouping.* **A. Haller** and **P. T. Muller.** (Comptes Rendus, 139. pp. 1180–1185, Dec. 26, 1904.)—The densities and specific refractions are given for the α-, γ-, and D-rays of solutions of approximately equal concentration in absolute alcohol of the ethyl esters of cyanacetic, cyanomalonic, propionylcyanacetic, and malonic acids, of malononitrile and cyanocamphor, and of their respective sodium salts. Since the difference between the molecular refraction for the D-ray of the acid and its salt is in each case greater than 2, varying from 2·73 for ethyl propionylcyanacetate to 6·19 for ethyl cyanacetate, it is concluded that the compounds are pseudo-acids, *i.e.*, the sodium salts differ in constitution from their acids. Probable constitutional formulæ are assigned to the salts, but are only provisional, further investigations being necessary. W. H. Si.

**1071.** *Potassium and Ammonium Nitrates and Bravais' Law.* **F. Wallerant.** (Comptes Rendus, 140. pp. 264–266, Jan. 23, 1905.)—Ordinary orthorhombic potassium nitrate changes at 129° into a rhombohedral modification (α), from which, on cooling, another rhombohedral form (β) can be obtained. It is not found possible to arrive at the β-variety directly from the original orthorhombic crystals. Sections perpendicular to the optic axis in the α-form remain perpendicular to this axis in the β-modification, but sections oblique to the optic axis clearly exhibit a difference in their double refraction. Fused ammonium nitrate crystallises in cubes, which, on cooling, become transformed into uniaxial crystals, regarded by Wyrouboff as tetragonal. At 82°, these uniaxial crystals undergo considerable expansion and are converted into an orthorhombic form, which, on cooling, yields the ordinary variety. If the tetragonal crystals are prevented from expanding at 82°, they pass directly into the ordinary form, which then presents a peculiar form of twinning. If these crystals are cooled very considerably, there appear two very perfect cleavage planes with an angle between them of about 120°. On cooling still further, the crystals become rhombohedral, the optic axis then coinciding with the obtuse bisectrix. Potassium and ammonium nitrates are therefore trimorphous, allow of similar orientation and form mixed crystals. But, in spite of this, the crystals of the two salts obtained at the ordinary temperature exhibit totally different faces. Confirmation is thus given to the conclusion that the law of Bravais has no general applicability, being unable in many cases to indicate the true nature of the space-net of crystals. T. H. P.

**1072.** *Compounds of Samarium Chloride with Ammonia Gas.* **C. Matignon** and **R. Trannoy.** (Comptes Rendus, 140. pp. 141–143, Jan. 16, 1905.)—Anhydrous samarium chloride absorbs in the cold a considerable quantity of ammonia gas, losing meantime its yellowish colour and swelling up considerably. Eight compounds are formed, which are given in the following table, together with their absolute dissociation temperatures, T, under normal pressure, and their heats of dissociation, Q, in cals.

| | T | Q | | T | Q |
|---|---|---|---|---|---|
| $SmCl_3,NH_3$ ......... | 648° | 20·7 | $SmCl_3,5NH_3$......... | 378° | 12·1 |
| $SmCl_3,2NH_3$ ...... | 513° | 16·4 | $SmCl_3,5NH_3$......... | 349° | 11·2 |
| $SmCl_3,3NH_3$ ...... | 473° | 15·1 | $SmCl_3,9{\cdot}8NH_3$ ...... | 313° | 10·0 |
| $SmCl_3,4NH_3$ ...... | 428° | 13·7 | $SmCl_3,11NH_3$ ...... | 288° | 9·2 |

T. H. P.

**1073.** *Viscosity of Liquid Mixtures.* Part II. **A. E. Dunstan.** (Chem. Soc., Journ. 87. pp. 11–17, Jan., 1905. Zeitschr. Phys. Chem. 51. pp. 732–738, May 9, 1905.)—Mixtures of water with *n*-propyl or allyl alcohol give curves possessing maxima, whilst mixtures of water with glycol, glycerol, or lactic acid do not. Mixtures of benzene with acetic acid or *n*-propyl alcohol show no maxima. The author endeavours to trace a connection between molecular association and increase of viscosity. Judging by the quotient of molecular volume by viscosity, associated liquids can be distinguished from non-associated liquids. [See also Abstract No. 2747 (1904).] F. G. D.

1074. *Constants of Pure Methane. Action of Solid Methane on Liquid Fluorine.* **H. Moissan** and **Chavanne.** (Comptes Rendus, 140. pp. 407–410, Feb. 13, 1905.)—Determinations of the density, at 0° and 760 mm. pressure, of pure methane prepared by the action of water upon aluminium carbide, give the values 0·5540 and 0·5554, the theoretical number being 0·555. The boiling-point is found to be —164° under 760 mm. pressure, and the melting-point —184°. Solid methane and liquid fluorine react explosively at —187°. T. H. P.

1075. *Normal Basicity of Alkaline Periodates.* **F. Giolitti.** (Accad. Lincei, Atti, 14. pp. 217–220, Feb. 19, 1905.)—The author has applied Böttger's method of determining basicity to periodic acid—the method depends on the use of the electrometer as alkalimetric and acidimetric indicator (Zeitschr. Phys. Chem. B. 24. p. 253). The results show the bi-basicity of periodic acid, and are thus in accord with the conclusions derived from the application of other physical methods (calorimetric measurements, determination of electrical conductivity) to the same problem. D. H. J.

1076. *Isodimorphism.* **F. Wallerant.** (Comptes Rendus, 140. pp. 447–449, Feb. 13, 1905.)—In the case of substances belonging to two different systems it is recognised that true isomorphism is not possible even if the angles of the two substances are very near together. Isodimorphism is, however, possible, and there can, therefore, be four different series of crystals, of which two are stable and two labile. Thus the stable form of potassium nitrate is biaxial, but the stable form of rubidium nitrate is uniaxial; in this case the possible combinations are :—

| | |
|---|---|
| $RbNO_3(+KNO_3)$ | Uniaxial stable |
| $KNO_3(+RbNO_3)$ | Biaxial stable |
| $RbNO_3(+KNO_3)$ | Biaxial labile |
| $KNO_3(+RbNO_3)$ | Uniaxial labile. |

In this table the form of the crystal is in each case that of the first component, the second component (bracketed) being a minor constituent. The first two forms can be obtained by crystallisation from solution. The fourth form has been prepared by the author by cooling a mixture of the fused salts; potassium nitrate becomes uniaxial when the temperature is raised, and when mixed with rubidium nitrate the labile uniaxial form can be preserved at atmospheric temperatures. The third type of mixed crystal might conceivably be prepared at low temperatures, but is at present unknown. T. M. L.

1077. *Etching Steel Sections.* **W. C. Smeaton.** (Iron and Steel Mag. 9. pp. 222–230, March, 1905. Contribution from the Chem. Lab. of the University of Michigan.)—The author found some trouble in etching, due to surface films [see Abstract No. 2506B (1904)], particularly after polishing with wet rouge. Two per cent. sulphuric acid, acting at 60° C. for 2 min., has been found to successfully remove films, whilst giving a light etch. The etching action of solutions of nitric acid and other agents was found to be, qualitatively, roughly proportional to the degree of electrolytic dissociation of the active agent. Solutions of the potassium and sodium salts of nitric, sulphuric, and hydrochloric acids are without action, but the ammonium salts have actions, increasing with concentration and temperature, similar to those of the acids; the active agent is the free acid arising from hydrolysis. Persulphates promise to be useful etching agents; and etching in all cases at slightly elevated temperatures is valuable, the rate of reaction being approximately doubled by each 10° rise. 40° is most suitable for etching with 2 per cent. ammonium nitrate. F. R.

1078. *Removal of Oxygen by Platinum.* **A. Magnus.** (Phys. Zeitschr. 6. pp. 12–13, Jan. 1, 1905.)—Goldstein has recently described a method of freeing gases from oxygen, based upon Wöhler's observations on the oxidation of platinum [see Abstract No. 661 (1905)]. In the modified method now described, the metal (Pt, Ir, or Pd) is fixed in the form of wire or foil between stout platinum wires, dipping into tubes of barometer length containing mercury. The metals were heated to a white heat by a current, and the alterations in the gas-pressure observed. When oxygen was present, and the metal was platinum or iridium, the decrease in pressure represented the proportion of oxygen in the gas. Thus in the case of air the pressure, originally 0·700 mm., sank to 0·625 mm. in 2 min., and in 5 min. to 0·605; at the end of 20 min. it remained constant at 0·555, with an absorption of 20·7 per cent. Palladium could not be used on account of its very rapid sublimation. When the filament of a glow lamp was used the pressure fell from 0·210 to 0·005 mm.; the absorption in this case amounted to 98 per cent., and both oxygen and nitrogen must have been absorbed. T. M. L.

1079. *Oxygen Absorption by Platinum and Iridium.* **R. Lucas.** (Zeitschr. Elektrochem. 11. pp. 182–185, March 24, 1905.)—In their investigation of the equilibrium between $SO_3$, $SO_2$, and O, Bodländer and Köppen [see Abstract No. 3039 (1904)] had noticed that platinum absorbed oxygen at temperatures above 460°, when L. Wöhler's platinum oxide is completely decomposed. The author finds that this absorption begins at 615° C., is very rapid between 900 and 1,000°, and decreases at higher temperatures, at which the quartz tubes failed. As, however, Holborn and Austin [see Abstract No. 1395 (1903)] had observed that the platinum metals are destroyed by heat only in an oxygen atmosphere, and iridium much more readily than platinum, the author concluded that his absorption might be due to the 1 or more per cent. of iridium always present in ordinary platinum. Pure platinum from Heraeus, indeed, did not absorb oxygen between 500 and 900°. The author considers, therefore, that Goldstein's somewhat similar experiment [see Abstract No. 661 (1905)] should be repeated. H. B.

1080. *Combustion of Sulphur in the Bomb Calorimeter.* **H. Giran.** (Comptes Rendus, 139. pp. 1219–1221, Dec. 26, 1904.)—The author has determined the heat of combustion of sulphur in dry oxygen under pressures varying from 1 to 45 atmospheres, and the amounts of sulphur dioxide and trioxide produced thereby. From these, the heat of formation at different pressures is calculated, taking that of sulphur trioxide from sulphur dioxide and oxygen, as 34·4 cal. The heat of formation of sulphur dioxide is found to rise proportionally to increase of pressure up to 35 atmospheres, after which it rises more slowly and appears to approach a limit. The percentage of sulphur oxidised to trioxide also increases in a similar manner, but there is less tendency to a limit. The evolution of more heat at greater pressures is ascribed to the formation of a higher oxide, probably persulphuric anhydride, in increasing quantities, the characteristic properties of this oxide being shown by the residue in the bomb. The heat of formation of sulphur dioxide under atmospheric pressure, obtained by extrapolation of the results so found, is + 69·80 cal., a figure intermediate between those given by Berthelot and Thomsen. W. H. Si.

1081. *Chemical Combination of Hydrogen and Oxygen when Subjected to the Action of Radium Emanation.* **C. W. Edwards.** (Science, 21. p. 109, Jan. 20, 1905.)—The quantity of gas converted into water per sec. was $18 \times 10^{-7}$ c.cm. when using 5 mgm. of radium bromide as the active agent. The number of molecules of water formed per sec. was calculated to be $48 \times 10^{13}$, and the number of ions producing the combination, as deduced from the saturation-current, $7·32 \times 10^{9}$. It is therefore supposed that each ion produced 6,500 molecules of water, "a result far in excess of expectations or theoretical predictions." T. M. L.

1082. *Cause of the Period of Chemical Induction in the Union of Hydrogen and Chlorine.* **D. L. Chapman** and **C. H. Burgess.** (Roy. Soc., Proc. 74. p. 400, Feb. 24, 1905.)—That hydrogen and chlorine only combine after some time when a mixture of these gases is exposed to light is usually attributed to the preliminary formation of an unstable intermediate compound. The authors' experiments show, however, that this phenomenon is due to the presence in the gas, or in the aqueous solution in contact with it, of substances capable of reacting with chlorine. Water, and more particularly aqueous salt solutions, possesses the power of rendering inactive chlorine which was previously active towards hydrogen. On long contact with chlorine in the presence of light, or on boiling with chlorine, these solutions lose this property even after subsequent removal of the chlorine by exhaustion, but regain it on the introduction of substances which react with chlorine. The most effective compound for this purpose is ammonia, minute traces of which are capable of preventing the action between hydrogen and chlorine for a period of time many times longer than has been previously observed. Sulphur dioxide also acts in this way, but is more easily removed on exposure to light. When an active mixture of hydrogen and chlorine is kept in the dark for some time the gases do not lose their activity, as is usually supposed, but immediately combine on exposure to light without any period of gradual acceleration. T. H. P.

1083. *Influence of Inactive Substances on the Optical Rotation of Glucose.* **I. A. Milroy.** (Zeitschr. Phys. Chem. 50. pp. 443–464, Dec. 30, 1904. II. Chem. Inst. d. Univ., Berlin.)—The solutions examined contained in all cases 15 gm. of glucose in 100 c.cm. It was found that acids and neutral salts produced a slight increase of rotatory power, whilst bases (organic and inorganic) and alkaline salts such as borax and aniline hydrochloride produced a very marked decrease. This decrease may be attributed to the formation of salts of lower rotatory power. A few salts, such as magnesium sulphate, copper nitrate, and ferric chloride, produced no change of rotatory power. Organic substances, such as the alcohols, acetone and aldehyde, produced an increase of rotatory power, but phenol and pyrogallol produced a slight decrease.

T. M. L.

1084. *Studies in Optical Superposition.* I. **T. S. Patterson** and **F. Taylor.** (Chem. Soc., Journ. 87. pp. 33–42, Jan., 1905.)—The molecular rotatory power of *l*-menthol, which is — 77·24° at 100°, reaches a maximum negative value — 77·94° at 58–59°, and decreases again to the melting-point at 42° C.; the rotatory power of the supercooled menthol at — 35·2° is 77·58°, and at about 20° it would probably fall to the same value as at 100°. A similar maximum of rotatory power has been observed in two other cases, but no maximum is observed either in the acetate or in the *d*-tartrate of *l*-menthol. The menthyl group seems to be very little affected by changes of temperature, the change of molecular rotation of menthol between 60° and and 100° being only + 0·7°, and that of the acetate between 0° and 100° being + 2·3°. The tartrate group, however, suffers large changes, the alteration of molecular rotation between 0° and 100° being + 11°, + 16·9°, and + 15·85° in the case of the methyl, ethyl, and propyl esters. In accordance with this the molecular rotation of menthyl tartrate changes by 23·5°, of which about 2 × 2·3° may be assigned to alterations in the menthyl, and the remaining 18·9° to alterations in the tartrate radicals. Similar observations are described in the case of the diacetyl compounds.

T. M. L.

1085. *Optical Investigation of Naphtha and its Distillation Products.* **M. A. Rakusin.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 37. No. 1. pp. 85–91, 1905.) —Previous work has established the optical activity (always dextro) of petroleum, and thus supported the view that it is of organic origin and contains asymmetric carbon atoms. In the present paper a further table of rotations is given for different petroleum products [see Abstract No. 2593 (1904)]—the highest rotation given, viz., + 3·6° in a Ventzke polarimeter with a 200 mm. tube, was obtained with a dark orange Baku machine oil of sp. gr. 0·9077 [at 15°]. The table shows that the rotation increases with the sp. gr. of the petroleum product, and that an optical examination may be of practical use in distinguishing machine oils. The rotivity of naphtha is certainly not to be ascribed to changes during the refining processes, as these rather diminish than increase the rotivity, although the latter is of remarkable persistency. Almost all vegetable oils are of lævo-rotation (unlike naphtha). The exceptions are castor, croton, and sesamé oils, which are dextro. The unsatisfactory character of our present data for these oils is shown by the following table, in which Column I. gives the author's own determinations of rotivity (Ventzke degrees), Column II. those given in Benedikt's Analyse der Fette und Wachsarten :—

| Name. | I. | II. |
|---|---|---|
| Castor oil ............... | + 8° | + 40° |
| Croton oil ............... | + 14·4° | + 4·3° |
| Sesamé oil ............... | + 2·2° | From + 3·1° to + 9° |

The author points out that his value for castor oil cannot be regarded as accidental, as it agrees with that found by Walden in 1894.

D. H. J.

1086. *Optically Active Nitrogen Compounds.* **Miss M. B. Thomas** and **H. O. Jones.** (Cambridge Phil. Soc., Proc. 13. pp. 33–34, Feb. 13, 1905.)—The rotatory power was determined in aqueous solution of a series of quaternary ammonium salts. In each case three of the radicals were phenyl, benzyl, and methyl; the remaining radicals were—

| | | | | | |
|---|---|---|---|---|---|
| Ethyl ............ | $[M]_D$ | $-19°$ | Isopropyl......... | $[M]_D$ | $-393°$ |
| Allyl ............... | $[M]_D$ | $-166°$ | Isoamyl ......... | $[M]_D$ | $-370°$ |

The rotatory powers are those of the active basic ions, and it is noteworthy that (1) the unsaturated allyl group gives a relatively low rotation, and that (2) the replacement of ethyl by isopropyl or isoamyl changes the rotatory power by 370° or 350°. The iodides of the isopropyl and isoamyl compounds are stable in alcoholic solution, $[M]_D = -428°$ and $-478°$ respectively, but racemise rapidly when dissolved in chloroform. [See also Abstract No. 2324 (1904).] T. M. L.

1087. *Influence of Solvents on Rotation of Optically Active Compounds.* Part VIII. *Ethyl Tartrate in Chloroform.* **T. S. Patterson.** (Chem. Soc., Journ. 87. pp. 313–320, March, 1905.)—Data are given for the rotation of ethyl tartrate in chloroform solution at various concentrations and temperatures. So far as the influence of temperature change is concerned, solution in chloroform has no very striking effect, and the curves expressing the data are all of much the same character. The influence of varying concentration, however, is much more marked; so profound is the change produced on the rotation of ethyl tartrate by admixture with chloroform, that the value of the specific rotation of the ester at 20°, viz., + 7·76, is reduced to half by the addition of only 20 per cent. of the solvent. The author shows that the changes in rotation mentioned above are closely related with the changes in "solution-volume" of the dissolved tartrate. [See also Abstract No. 856 (1905).] D. H. J.

1088. *Dextro-lactic Acid.* **E. Jungfleisch** and **M. Godchot.** (Comptes Rendus, 140. pp. 719–721, March 13, 1905.)—It has already been shown by one of the authors that the extraction of *d*-lactic acid from the *d*-lactates involves, under certain conditions, more or less transformation of the *d*-acid into the $(d+l)$-acid; the authors describe in the present paper the exact conditions for obtaining perfectly pure *d*-lactic acid. *d*-Lactic acid forms prismatic needles, differing completely in appearance from the $(d+l)$ crystals, and melting 7° or 8° higher. The dextro-rotivity diminishes when the dilution increases; thus a solution of 1·527 gm. of crystallised acid in 100 c.cm. gave $a_D = +2·61$; solutions of 10·458, 5·022, and 2·511 gm. in the same volume gave, at 15°, for $a_D$, $+3·82°$, $+3·33°$, and $+2·67°$ respectively. [See also Abstract No. 3029 (1904).] D. H. J.

1089. *State in which Helium Exists in Minerals.* **M. W. Travers.** (Nature, 71. pp. 248–249, Jan. 12, 1905.)—Jaquerod [see Abstract No. 4 (1905)] has found that when helium is heated in a quartz bulb to a temperature above 500° C. the gas passes out through the quartz with a velocity which increases with the temperature. At 1,100° in a comparatively short time the pressure in the bulb fell considerably below that of the atmosphere. Hydrogen appeared to behave similarly. This experiment shows that quartz, and probably substances such as those which liberate helium when heated, are impermeable to the gas at low temperatures, but become permeable when the temperature is raised. It is suggested (1) that the helium, a product of radio-active change, is present in the minerals in a state of supersaturated solid solution ; (2) that the mineral substance being impermeable to the gas at ordinary temperatures, the velocity with which equilibrium is established between the helium in solution and the helium in the gaseous phase is infinitely small, but increases very rapidly with rise of temperature ; (3) that as the solubility of helium in the mineral substance is probably very small, the mineral cannot be made to re-absorb the gas. Grinding even to an impalpable powder, if unaccompanied by local heating, should result in the evolution of minute quantities of helium only, and this was actually the case in the recent experiments of Moss [see Abstract No. 422 (1905)]. T. M. L.

1090. *Physical Properties of Calcium and its Amalgam.* **H. Moissan** and **Chavanne.** (Comptes Rendus, 140. pp. 122–127, Jan. 16, 1905.)—A sample of the metal calcium prepared at Bitterfeld has been tested. It is of 99·3–99·6 per cent. purity. It is easily turned into brilliant cylinders, which tarnish rapidly in damp air, and is sufficiently tenacious to give wires of 0·5 mm. diam. Its specific electrical resistance was found to be $105 \times 10^{-8}$, giving a conductibility compared with silver, taken as 100, equal to 15·6. The fusion point is 810° C. The density, tested in chloroform and carbon tetrachloride, is 1·548. It easily amalgamates with mercury, giving a crystalline product corresponding to $Hg_8Ca$, which is stable in dry air at the ordinary temperature. W. W. H. G.

1091. *Melting-points of Mixtures of Sugars.* **H. Gillot.** (Acad. Roy. Belg., Bull. pp. 834–854, 1904.)—Examination of the melting-points of mixtures, in pairs, of the sugars, mannitol, dulcitol, dextrose, sucrose, and lactose, shows that the melting-point is never exactly the mean of those of the two constituents of the mixture, and that the addition of minute quantities of one sugar to another lowers the melting-point of the latter even when the added substance has the higher melting-point. The configuration of the melting-point curves indicates that, except in the cases of the sucrose-lactose and sucrose-dulcitol mixtures, the mixed sugars form definite compounds. The curve for sucrose-dulcitol mixtures has three branches, probably owing to the formation of isomorphous mixtures. T. H. P.

1092. *Temperature and Solubility. Lecture Experiment.* **P. Mueller.** (Zeitschr. Elektrochem. 11. p. 3, Jan. 6, 1905. Phys. chem. Abt. des chem. Universitätslaborat., Breslau, Nov., 1904.)—When equal volumes of water and *i*-butyl alcohol are shaken in a test tube at 25°, the two liquids separate. When the test tube is lowered into cold water, the upper layer, which is richer in alcohol, becomes turbid by the separation of drops of a phase in which water predominates. When heated in a water bath, the upper layer becomes clear again, but the lower layer turns turbid, as it cannot dissolve so much alcohol at higher temperature. This experiment is more striking than Nernst's demonstration with solutions of ether and water. H. B.

1093. *Condition of Chlorine in Colloidal Solutions of the Metal Hydroxides.* **R. Ruer.** (Zeitschr. Anorg. Chem. 43. 1. pp. 85–93, Jan. 16, 1905. Inst. für anorg. Chemie der Univ., Göttingen, Nov., 1904.)—It was found by Hantzsch and Desch (Liebig's Ann. d. Chemie, 323. p. 28, 1902) that ferric hydroxide prepared by dialysis always contains chlorine, which, however, does not give the reaction with silver nitrate until after it has been warmed with nitric acid. The author has observed the same thing to occur with zirconium hydroxide. He regards this as being due to a specific action of the colloidal hydroxide, whereby the silver chloride is retained in colloidal solution, so that the particular metal colloid acts as a "protective" colloid. He considers there is no reason for assuming formation of complex ions. A. F.

**1094.** *Composition of Colloidal Granules.* **V. Henri** and **A. Mayer.** (Comptes Rendus, 139. pp. 974–976, Dec. 5, 1904.)—From the results of Duclaux's experiments is calculated the coefficient of partition of the ferrocyanide group $Fe(CN)_6$ between the intergranular liquid and the granules formed by the addition of copper chloride to potassium ferrocyanide. The ratio of $K_4Fe(CN)_6$ in the granules to that in the intergranular liquid is shown to diminish proportionally to the increase of $K_4Fe(CN)_6$ in the mixture—a result which is in accordance with the absorption of electrolytes and tinctures by different colloids. It is concluded that the variation in composition of colloidal precipitates studied by Duclaux may be regarded as a particular case of the phenomenon of absorption, without assuming the formation of chemical compounds of varying composition. [See also Abstracts Nos. 929 and 2416 (1904).] W. H. Si.

**1095.** *Quartz Glass in Laboratory Use.* **F. Mylius** and **A. Meusser.** (Zeitschr. Anorg. Chem. 44. 3. pp. 221–224, March 24, 1905. Communication from the Physikal. Techn. Reichsanstalt.)—Quartz vessels supplied by Heraeus have been tested as regards chemical behaviour. Water is found to have no action on vitreous silica at either ordinary or boiling temperature, but solutions of ammonia, soda, potash, and of salts having an alkaline reaction, dissolve silica; the action is apparent even at low temperatures, but is accelerated by heat; the action, however, leaves the surface of the quartz as smooth as when new. Barium hydrate solution, kept in a quartz vessel for six months, air being excluded, formed small prismatic crystals on the walls of the vessel; these were found to be barium silicate. Dilute acids, with the exception of hydrofluoric acid, have no action, and concentrated sulphuric acid is also without sensible action at 18° and at 100° C. Phosphoric acid is without action at 18°, but on concentrating in a quartz crucible an action sets in beyond 400°, which results in deep corrosion of the vessel and the formation of a white silicon phosphate. Hydrofluoric acid is a powerful solvent. From a 30 per cent. solution of potash quartz vessels absorb alkali which cannot be removed by repeated rinsing with cold water, but can be redissolved by boiling with water. A similar solution of caustic soda shows no such action. Quartz vessels have the power of absorbing certain colouring matters, such as methylene blue, kongo red, and ether solution of iod-eosin; the quantities absorbed are very minute—much less than in the case of ordinary glass—and can be removed by means of hot solvents. Whether quartz vessels absorb any water remains to be investigated. The advantage of using vitreous silica for obtaining the mirror in arsenic testing is pointed out, but it is always necessary to protect the silica from the direct contact of the gas-flame, as this causes marked corrosion. W. Ros.

**1096.** *Conductivity of Mixtures of Solids.* **H. Reynolds.** (Beibl. Ann. d. Physik, 28. 2. pp. 121–122, 1904. Supplemented by extracts from the author's Göttinger Dissertation, 1902.)—Different oxides in finely-powdered form were mixed with 6 per cent. tragacanth and 3 per cent. dextrin, and made into a paste, and then pressed into long threads about 1 mm. thick. They were subjected to the O–H blowpipe flame, and then portions of about 2 cm. long were heated to 800–1,400° in an electrical resistance furnace. Their conductivity was ascertained by Kohlrausch's method. The first mixtures experimented upon were—

I. 9 mol. $ZrO_2 + 1$ mol. $Y_2O_3$
II. 9 mol. $Co_2O_3 + \frac{1}{2}$ mol. $Fe_2O_3$
III. 90 per cent. $Co_2O_3$ + 10 per cent. CdO.

It was found that at a definite temperature the conductivity was a constant property for rods of the same composition. The influence of the change of a constituent was next tested, and mixtures of—

IV. 84 per cent. $ZrO_2$ + 15 per cent. $Er_2O_3$ + 1 per cent. CaO
V. ” ” ” ” ” $Al_2O_3$
VI. ” ” ” ” ” MgO
VII. ” ” ” ” ” $CeO_2$

gave approximately rods of the same conductivity. Other mixtures tried were—

VIII. 85 per cent. $ZrO_2$ + 15 per cent. $Y_2O_3$
IX. 85 per cent. $ZrO_2$ + 15 per cent. $Sm_2O_3$
X. 85 per cent. $ZrO_2$ + 15 per cent. $La_2O_3$.

The pure oxides were found to be bad conductors. Only at 1,500° C. does MgO show any conducting power. The relation between conductivity and molecular weight was investigated. The rods were composed of 9 mols. of $ZrO_2$ with 1 mol. of one of the following oxides: $Li_2O$, BeO, MgO, CaO, SrO, BaO, $Al_2O_3$, $Y_2O_3$, $TiO_2$, $CeO_2$, $ThO_2$, $P_2O_5$, $Cr_2O_3$, $UO_3$, $Co_2O_3$, or $Fe_2O_3$. No definite relation could be established. The effect of temperature in most cases was given by the law: $1000\lambda = (1 + \xi)^{\frac{T-\theta}{100}} - 1$, where $\lambda$ = conductivity, $\xi$ = a constant, T = the temperature of the substance, $\theta$ = the temperature at which it commenced to conduct. The influence of concentration was next studied in the case of rods of $ZrO_2$, mixed with different quantities of either MgO or $Y_2O_3$. The curves of results show minimum points. It was found that the hysteresis of the rods was a well-defined phenomenon. The behaviour of $Co_2O_3$, alone, or mixed with $Fe_2O_3$, MgO, $ZrO_2$, or $Y_2O_3$ was also studied.

W. W. H. G.

**1097.** *Use of Carbon for Electric Furnace Temperatures.* **F. A. J. FitzGerald.** (Amer. Electrochem. Soc., Trans. 6. pp. 31–37, 1904.)—If amorphous carbon is heated to high temperatures, physical and chemical differences in its properties are observed, such as (1) increase in density, (2) increase in heat conductivity, (3) decrease in electrical resistance, (4) increased resistance to oxidation, (5) increased resistance to the disintegrating action of certain solutions. By taking advantage of the first of these changes a useful method for the study of temperatures is found. If carbon is raised to a temperature sufficiently high to cause the change to graphite, the alteration of density does not cease, but continues with still higher temperatures until a certain point is reached. The absolute densities were determined by means of a specific gravity bottle, alcohol being used as the liquid in the bottle for the reason that it wets carbon much more readily than water. A Sprengel pump was employed to remove the air from the pores of the carbon. An accuracy of 0·044 per cent. was attained. The density of carbon samples at 20° compared with water at 4° C. is given below :—

| Specimen. | Temperature. | Density. |
|---|---|---|
| 1 | Dull redness | 1·9141 |
| 2 | Above melting-point of $CaC_2$, below that of Ag... | 1·9612 |
| 3 | Above melting-point of Ag | 1·9853 |
| 4 | Above melting-point of Cu, below that of cast-iron | 2·0061 |
| 5 | Above melting-point of cast-iron | 2·0363 |
| 6 | Heated in Pt crucible over blast lamp, crucible packed with $Al_2O_3$, radiation of heat diminshed by a shield of asbestos | 2·0585 |

The conclusion of Moissan (*Le Four Electrique*, p. 58), that the polymerisation of carbon is a function of the time of heating was verified, as indicated by the continued increase of density as the heating was continued. It is shown that this method of determining temperatures may be of considerable value in practical working, in indicating the relative temperatures at different parts of furnaces and in improving their design, but it is admitted that further experimental tests are desirable. W. W. H. G.

1098. *Tantalum: Preparation and Properties.* **W. v. Bolton.** (Zeitschr. Elektrochem. 11. pp. 45–51, Jan. 20, 1905. Electrochem. Ind., N.Y. 3. pp. 52–53, Feb., 1905.)—The tantalum of Moissan obtained in the electric furnace was probably a carbide or an alloy of carbide [see Abstract No. 182 (1903)]. It was found that a pure tantalum could be obtained by the electrolysis of the potassium tantalofluoride, and then melting the finely-divided metallic powder so produced in vacuum [see Abstract No. 413B (1905)]. *Physical Properties.*—Melting point, 2,250–2,300° C.; specific heat, 0·0365; atomic heat, 6·64; density, bars 16·64, wires 16·5; linear coefficient of expansion, 0·0000079; specific resistance (1 m., 1 sq. mm. section), 0·165; temperature coefficient, 0–100° 3 per cent., 0–350° 2·6 per cent.; modulus of elasticity, 19,000 kg./sq. mm.; tenacity, 1 mm. wire 93 kg./sq. mm., 0·05 mm. wire 150–160 kg./sq. mm.; place in tension-series between Pt and Ag. [For properties as a filament see Abstract No. 491B (1905).] It can be beaten into sheets, after beating to redness, by a steam hammer, and becomes excessively hard. An experiment was made on a sheet of 1 mm. thick. It was attempted to perforate it with a diamond borer at 5,000 r.p.m., but after three days and nights only a small depression of $\frac{1}{4}$ mm. deep resulted, and the diamond tool was much worn. The metal hence possesses extraordinary hardness with great ductility, a combination of qualities which may be of great workshop value. When two electrodes of tantalum are immersed in dilute $H_2SO_4$ no current can be passed through the bath. With a voltage of 220, at the moment of closing the current the anode becomes covered with a strong oxide layer of an insulating nature. If an electrode of tantalum and one of platinum be used, no current passes when the anode is the tantalum. When heated in a vacuum up to 2,250° C. it is but little evaporated. It absorbs hydrogen and nitrogen very strongly. Thin wires can be burnt in the air, giving a white light. The action of S, Se, Te, Fe, Ag, Hg, Mo, W, $CO_2$, and various acids and alkalies, is described. W. W. H. G.

**1099.** *Thermo-chemistry in the Electric Furnace.* **H. Allen.** (Cassier, 27. pp. 358–362, March, 1905.)—As an aid to the study of the thermo-chemistry of the manufacture of steel and the reduction of ore in the electric furnace the following data have been compiled from various authorities :—

SPECIFIC HEATS.

| | |
|---|---|
| $Fe_3O_4$ | 0·154 |
| $Fe_2O_3$ | 0·171 |
| Cast iron | 0·1124 |
| Iron | 0·10601 + 0·00014t° C. |
| Steel | 0·1217 |
| Carbon (graphite) | 0·1604 |
| „ (charcoal) | 0·1935 |
| „ (coke) | 0·1571 |
| Slag | 0·148 |
| Manganese | 0·1217 |
| Silicon, crystalline | 0·1697 |

HEATS OF COMBINATION, per lb. in B.Th.U.

| | | | |
|---|---|---|---|
| Fe | to | $Fe_3O_4$ | 2,880 |
| Fe | „ | $Fe_2O_3$ | 3,650 |
| C | „ | $CO_2$ | 14,544 |
| C | „ | CO | 4,451 |
| CO | „ | $CO_2$ | 4,350 |
| Si | „ | $SiO_2$ | 14,094 |
| Mn | „ | $MnO_2$ | 3,803 |
| (Board of Trade unit | | | 3,410) |

MELTING-POINTS.

| | |
|---|---|
| Pure iron | 2,730–2,900° F. |
| Grey cast iron | 2,910–3,450° F. |
| White „ „ | 2,530–2,730° F. |
| Steel | 3,272° F. |
| Magnetic oxide | 2,370° F. |

LATENT HEAT.

| | |
|---|---|
| Cast iron | 233 |
| Slag | 249 |

Examples showing the method of making the calculations in the case of several types of furnaces are given. W. W. H. G.

**1100.** *Quartz Vessels.* **Berthelot.** (Comptes Rendus, 140. pp. 817–820, and pp. 821–825, March 27, 1905. Chem. News, 91. pp. 191–192, April 28, and pp. 204–205, May 5, 1905.)—The use of fused quartz vessels enables chemical reactions to be studied at relatively high temperatures. They are made of small quartz tubes, and can be manipulated with the O-H or, still better, with the oxygen-acetylene blow-pipe. Tubes of about 10 mm. diam. and 100 mm. long have been used, of capacity 4 to 5 c.cm. with a wall-thickness of 0·7 mm. The resistance to internal pressure is about 8 atmos. at the moment they commence to soften, between 1,300°–1,400°. The substances are introduced and then the tube sealed. They were heated electrically by a platinum spiral. No precautions need be taken in cooling. The experiments show that the quartz is permeable to ordinary matter.

This has also been observed in the case of H by Villard, and by Jacquerod and Perrot for helium. Now the author proves it for N and O. Among the number of experiments may be cited as examples the following: (1) Amorphous carbon was sealed in a quartz tube and heated, a vacuum being at the same time produced. When the exhaustion was as perfect as possible the tube was sealed. It was then maintained between 1,300° and 1,325° for 30 min. At the end of this time it was cooled, and then opened under mercury. It was found to be full of gas containing 0·9 c.cm. N and 0·6 c.cm. of CO. (2) Pure oxygen was sealed in a 4 c.cm. tube and then heated to 1,300° for 90 min. Analysis then showed that 3 c.cm. of N had entered. (3) Naphthaline heated to 1,300° gave only carbon, the hydrogen having transpired through the walls of the tube. These and other facts show plainly that quartz under the conditions of the experiment acts like a membrane susceptible of endosmose and exosmose. W. W. H. G.

1101. *Quartz Tubes in Chemical Reactions.* **Berthelot.** (Comptes Rendus, 140. pp. 905–914, April 3, 1905.)—The introduction of quartz tubes has given, when compared with glass or porcelain, many facilities for research. Especially is this the case with reactions which can be studied by a sudden change from a high to a low temperature, for a quartz tube heated to redness can be suddenly cooled in cold water without rupture. Experiments have been made with small tubes, as previously described [see preceding Abstract] in a number of cases, such as the following: (1) *Pure oxygen* used. Capacity of tube 4 c.cm., initial pressure 36 cm., raised in one hour to a temperature of 1,300° C. and then kept for 30 min. at the same temperature. The tube was then suddenly cooled, when no traces of ozone could be detected. (2) *Nitrogen and oxygen.* Equal volumes heated to 1,300°–1,325°. Then cooled instantly. No trace of combination. (3) *Carbon and hydrogen.* Experiments performed with different forms of carbon showed that no hydrocarbon was formed at 1,325°. (4) *Acetylene* is decomposed with the formation of brilliant black carbon and liberation of hydrogen, which gas partly escapes through the walls of the tube by transpiration. (5) *Carbon and nitrogen.* No trace of cyanogen. W. W. H. G.

1102. *The System: Potassium Iodate, Iodic Acid, and Water at* 30°. **P. A. Meerburg.** (Chemisch Weekblad, 1. pp. 474–479, May 7, 1904.)—Results are given of measurements of the solubility of various mixtures of potassium iodate and iodic acid at 30°. Solutions containing 9·51 per cent. of potassium iodate or 76·70 per cent. of iodic acid are saturated at this temperature. Compounds of the compositions $KIO_3$, $HIO_3$ and $KIO_3, 2HIO_3$, may separate from solution. T. H. P.

1103. *Colouration of Glass Exposed to Radiations.* **W. Crookes.** (Roy. Soc., Proc. 74. pp. 524–528, April 10, 1905.)—The fact is well known that many samples of colourless glass containing manganese assume a violet tint when exposed to sunlight; the introduction of manganese is to neutralise the colour caused by iron. Iron gives a greenish tint, and the addition of $MnO_2$ performs the double object of oxidising the iron salt and imparting a purple shade which neutralises the green-yellow tint of the iron silicate. The author has obtained samples from an altitude of 4,000 ft. that were exposed in Bolivia. The pieces of glass are all depths of tint, from deep violet—almost black in thick pieces—to pale amethyst. Analysis proves the presence of manganese. Heating the glass in a covered crucible to its softening point discharges the colour. It is found that the colour is not superficial. A probable explanation of the colouring is that it is due to the intense solar radiation causing the ferric salt to become ferrous and the manganous salt to change to a manganic compound. It is not necessary to assume the action of radium, which has also the power to produce in a short time a deep colouring. Interesting examples of solar action are seen in the old greenhouses at Kew. Glass, coloured green with oxide of iron for use in the forcing houses, is found by long exposure to sunlight to gradually lose this tint, and to become perfectly colourless. Subsequently a purple colour, due to a small quantity of manganese, makes its appearance. W. W. H. G.

**1104.** *Solubility of Gypsum as Affected by Size of Particles and by Different Crystallographic Surfaces.* **G. A. Hulett.** (Amer. Chem. Soc., Journ. 27. pp. 49–56, Jan. 1905.)—The author has previously shown [see Abstracts Nos. 1963 (1901) and 2041 (1904)] that the solubility of gypsum depends on the size of its particles, and Rinne has since found (Centralbl. für Min. und Geol. p. 116, 1904) that the dissolution of gypsum crystals in hydrochloric acid is not uniform in all directions. In order to ascertain whether this is due to a dependence of the solubility on the nature of the crystal-face the author treats well-formed gypsum crystals for a long time with saturated gypsum solution. He finds that no alteration occurs in the lengths of the edges of the crystals, nor is the concentration of the solution diminished or increased. In determining the solubility of calcium sulphate it must be borne in mind that when equilibrium is approached from the undersaturated side the final state is only arrived at after half a day or more. From the supersaturated side, gypsum solution requires a period of some weeks, and very careful treatment to bring it to a state of equilibrium. T. H. P.

**1105.** *Mercury Thiocyanate Complexes.* **M. S. Sherrill** and **S. Skowronski.** (Amer. Chem. Soc., Journ. 27. pp. 30–47, Jan., 1905. Contribution from the Chem. Lab. of the Massachusetts Inst. of Technology.)—The increase of solubility of mercuric thiocyanate caused by the addition of potassium thiocyanate is found, when expressed in mols. per litre, to be always approximately equal to one-half of the number of molecules of potassium thiocyanate added, indicating in saturated solutions the quantitative formation of a complex of the formula $K_{2m}Hg_m(SCN)_{4m}$. The change of the freezing-point of moderately dilute solutions of potassium thiocyanate caused by the addition of varying amounts of mercuric thiocyanate is found to correspond with a removal from the solution of one molecule for every molecule of the mercuric salt added. This can only be explained by the formation of the complex $K_2Hg(SCN)_4$. The solubility of mercurous thiocyanate in potassium thiocyanate is also determined; this solubility results in virtue of the following reactions: $Hg_2(SCN)_2 \rightleftarrows Hg(SCN)_2 + Hg$; $m Hg(SCN)_2 + n SCN^- \rightleftarrows \{Hg(SCN)_2\}_m(SCN^-)_n$. The law of mass action hence requires that, when mercurous thiocyanate as solid phase is in equilibrium with a solution of potassium thiocyanate, the following equation must hold :—

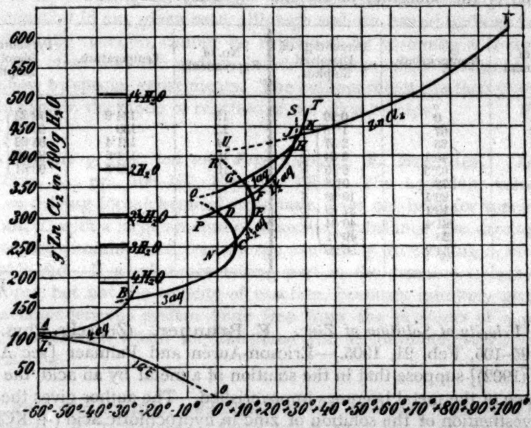
$$\frac{\{(Hg(SCN)_2)_m(SCN^-)_n\}}{\{SCN^-\}^n} = K_1\{Hg(SCN)_2\}^m = K.$$

Since mercuric thiocyanate is but slightly soluble in water, the total amount of mercuric salt in solution may be taken as a measure of the concentration of the complex. It is therefore possible, by assuming the existence of any one complex, to calculate K from the solubility of the mercurous salt and the concentration of the potassium thiocyanate. From the solubility of mercurous thiocyanate in different concentrations of potassium thiocyanate, the best constancy of the K values is obtained by assuming the complex to be $K_2Hg(SCN)_4$. This result is confirmed by measuring the e.m.f. of concentration cells of the type $Hg/\{Hg(SCN)_2 + KSCN\}$ (concentration 1)/$\{KSCN + Hg(SCN)_2\}$ (concentration 2)/Hg, and applying the law of mass action to the results. From the e.m.f. of such solutions measured against the normal calomel electrode, in which the concentration of the mercury ions is known, the concentration of the mercuric ions in the solution in question can be calculated, and from this the stability constant of the complex is found to have the value $9{\cdot}7 \times 10^{21}$, the constancy of which is evidence of the existence of the above complex salt throughout the whole range of concentration taken. The relative tendency of the halogens and of the cyanogen and thiocyanogen groups to form complexes increases in the following order: Cl, Br, SCN, I, CN. In solutions where the mercury electrode causes precipitation of mercurous thiocyanate, the concentration of the mercurous ions is calculated from the e.m.f. measured against the normal electrode. The concentration of SCN ions in such solutions can be calculated from the concentration of the potassium thiocyanate and the solubility of the mercurous salt. From these two values the solubility product of mercurous thiocyanate $\{Hg_2{+}{+}{+}\}\{SCN^-\}^2$ is calculated to be $1{\cdot}8 \times 10^{-20}$. T. H. P.

1106. *Contributions to Knowledge of the Polysulphides.* **F. W. Küster** and **E. Heberlein.** (Zeitschr. Anorg. Chem. 43. 1. pp. 53–84, Jan. 16, 1905.)—Measurements of the solubility of sulphur in sodium sulphide solutions and of the degree of hydrolysis of such solutions. The latter was estimated by determining the catalytic effect of the hydroxyl ions on diacetone alcohol (Koelichen's method). The solubility of sulphur in alkaline sulphide solutions is nearly independent of temperature between 0° and 50°, but depends very largely on the concentration of the sulphide, possessing a maximum value for $\frac{n}{16}$ sodium sulphide. For this maximum value the composition of the solution corresponds to $Na_2S_{5\cdot24}$. The sulphide solutions are all highly hydrolysed, but the hydrolysis decreases with the amount of sulphur dissolved, showing that the higher sulphides correspond to complex acids of gradually increasing strength. The authors show that all the numerous constitutional formulæ proposed for the polysulphides are unable to withstand a critical examination in the light of modern methods. The polysulphides are salts corresponding to the complex acids, $H_2S\,.\,S_x$, analogous to the complex acids $HI\,.\,I_2$ and $HI\,.\,I_4$. Solutions of S in $Na_2S$ solution contain a very complicated equilibrium mixture of the sodium salts of these acids and their ions, in which there appears to be a relatively large amount of the tetrasulphide and its corresponding ion $S'_4$. F. G. D.

1107. *Solubility of Metallic Hydroxides in Glycerine.* **A. Müller.** (Zeitschr. Anorg. Chem. 43. 2. pp. 320–325, Jan. 25, 1905.)—The phenomena observed during the formation of hydroxides in media containing glycerine vary according to the particular hydroxide and the concentration of the glycerine solution. To obtain comparable results the author dissolved a quantity of each metallic salt in 5 c.cm. of water, then added 20 c.cm. of glycerine, and finally 20 c.cm. of ammonia. The experiments extended to the hydroxides of beryllium, aluminium, chromium, iron, cerium, and neodymium. From the table of results given it appears that beryllium and ceric hydroxides are not at all soluble in the glycerine solution; aluminium and chromium hydroxides are only slightly soluble; iron, neodymium, and cerous hydroxides very soluble. In absence of air the undiluted clear solutions remain unchanged for weeks, and electrolytic action does not appear to cause change. If a solution saturated with hydroxide is diluted with water, the hydroxide is thrown down as a precipitate. In the case of cerous hydroxide the precipitation may be so regulated by the addition of water that the gradual change from clear solution to turbid liquid and finally to hydrogel can be very clearly traced. **D. H. J.**

**1108.** *Solubility of Zinc Chloride.* **F. Mylius** and **R. Dietz.** (Zeitschr. Anorg. Chem. 44. 3. pp. 209–220, March 24, 1905. Communication from the Physikal. Techn. Reichsanstalt.)—The authors have carried out very careful determinations of the solubility of anhydrous zinc chloride and of its crystalline hydrates in water. The relations which were here met with are very similar to those found in the case of ferric chloride studied by Roozeboom. The different hydrates which were found to exist are: $ZnCl_2, 4H_2O$; $ZnCl_2, 3H_2O$; $ZnCl_2, 2\frac{1}{2}H_2O$; $ZnCl_2, 1\frac{1}{2}H_2O$; $ZnCl_2, 1H_2O$. The accompanying Fig. gives the graphic representation of the relationships met with, the principal numbers from which it was constructed being as follows :—



| Temperature. ° | Solid Phase. | gm. $ZnCl_2$ to 100 gm. $H_2O$. | Curve, or Point. | Temperature. ° | Solid Phase. | gm. $ZnCl_2$ to 100 gm. $H_2O$. | Curve, or Point. |
|---|---|---|---|---|---|---|---|
| − 5 | ice | 14 | OL | 12·5 | $ZnCl_2 . 2\frac{1}{2}H_2O$ | 303 | E |
| −40 | " | 83 | " | 11·5 | $ZnCl_2 . 2\frac{1}{2}H_2O$ ; $ZnCl_2 . 1\frac{1}{2}H_2O$ | 335 | F |
| ca. −62 | ice, $ZnCl_2 . 4H_2O$ | 104 | LA | 9 | $ZnCl_2 . 2\frac{1}{2}H_2O$ ; $ZnCl_2 . H_2O$ | 360 | G |
| −30 | $ZnCl_2 . 4H_2O$ ; $ZnCl_2 . 3H_2O$ | 160 | B | 26 | $ZnCl_2 . 1\frac{1}{2}H_2O$ ; $ZnCl_2 . H_2O$ | 423 | H |
| 6·5 | $ZnCl_2 . 3H_2O$ | 252·4 | C | 26·3 | $ZnCl_2 1\frac{1}{2}H_2O$ ; $ZnCl_2$ | 433 | J |
| 0 | $ZnCl_2 3H_2O$ ; $ZnCl_2 . 1\frac{1}{2}H_2O$ | 309 | D | 28 | $ZnCl_2 H_2O$ ; $ZnCl_2$ | 436 | K |

**A. F.**

**1109.** *Contribution to the Theory of Solution.* **G. Martin.** (Journ. Phys. Chem. 9. pp. 149–155, Feb., 1905.)—The author endeavours to explain the phenomena of solubility and solution by referring them to the action of such intermolecular forces as are usually assumed to explain the phenomena of cohesion and capillarity. He arrives at the conclusion that every dissolved molecule will be surrounded by a vacuum, and will, according to conditions, either exist alone inside this "vacuum bubble" or exist therein in combination with one or more molecules of solvent. Many other conclusions are arrived at for which reference must be made to the original paper. F. G. D.

**1110.** *Solubility of Sulphur in Benzyl Chloride and some Properties of the Solution.* **J. Bogusky.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 37. No. 1. pp. 92–99, 1905.)—When sulphur is heated with benzyl chloride at temperatures below 136° there are in general two layers formed—one (the upper layer) a solution of sulphur in benzyl chloride, the other (the lower layer) a solution of benzyl chloride in sulphur. Above 136° we get a homogeneous liquid, *i.e.*, the sulphur dissolves in the benzyl chloride in all proportions. The phenomena are, therefore, exactly analogous to those investigated by Alexéef. The following table gives the results of the experimental determinations of the solubility of sulphur in benzyl chloride :—

| No. of Experiment. | Temperature. | Percentage of Dissolved Sulphur. | | No. of Experiment. | Temperature. | Percentage of Dissolved Sulphur. | |
|---|---|---|---|---|---|---|---|
| 1 | 0° | 0·99 | | 12 | 134·2° | 72·23 | Lower layer. |
| 2 | 67 | 1·78 | Upper layer. | 13 | 130 | 80·07 | |
| 3 | 35 | 2·57 | | 14 | 121·4 | 85·02 | |
| 4 | 46·1 | 3·64 | | 15 | 114·6 | 87·99 | |
| 5 | 63·3 | 6·15 | | 16 | 109·6 | 90·61 | |
| 6 | 78 | 9·88 | | | | | |
| 7 | 99·1 | 19·89 | | | | | |
| 8 | 118·1 | 37·29 | | | | | |
| 9 | 121·4 | 40·04 | | | | | |
| 10 | 130 | 49·71 | | | | | |
| 11 | 134·2 | 56·20 | | | | | |

D. H. J.

**1111.** *Velocity of Solution of Zinc.* **E. Brunner.** (Zeitschr. Phys. Chem. 51. pp. 95–105, Feb. 21, 1905.)—Ericson-Aurén and Palmaer [see Abstract No. 901 (1902)] suppose that in the solution of a metal by an acid, the acid at the surface of the metal becomes impoverished. The author gives the results of an investigation of the solution of zinc in hydrochloric acid (+ KCl) or in iodine solution or electrolytically; the methods employed have already been given [see Abstract No. 1223 (1904)]. With zinc which contains lead, the velocities of solution in hydrochloric acid are smaller than they would be if the concentration of the acid were zero over the whole surface of the metal. The diminution in concentration is hence, as a whole, inconsiderable, but at the places where hydrogen is evolved it must certainly occur. The theory that the action depends to some extent on diffusion does not contradict the theory of local currents but augments it. Other explanations are, however, possible. The fact that iodine is reduced by zinc as rapidly as it is electrolytically confirms the supposition that the insolubility of pure zinc in dilute acids depends on the difficulty of formation of molecular hydrogen. In the solution of pure electrolytic zinc in iodine solution the concentration of the iodine at the surface of the metal is indefinitely small, so that the velocity of the reaction is determined only by the diffusion of the iodine; zinc containing lead dissolves in iodine solution with a smaller velocity, which rapidly falls off. In the anodic solution, both of pure zinc and of zinc containing lead, in a good conducting solution (0·001*n*) of a zinc salt, the dependency of the concentration of zinc ions at the anode on the polarisation corresponds with Nernst's formula, but in strong solutions (up to 0·01*n*) of zinc salts the concentration of the zinc ions is smaller, so that the current density for a given polarisation is almost independent of the $Zn^{\cdot\cdot}$-concentration. A theory comprehending all these observations cannot be devised. T. H. P.

1112. *Mechanism of Ether-formation from Alcoholate and Alkyl Haloid or Dinitrobenzol Haloid.* **C. A. Lobry de Bruyn** and **S. Tijmstra Bzn.** (Zeitschr. Phys. Chem. 50. pp. 436–442, Dec. 30, 1904. Organ. Chem. Laborat. Amsterdam.)—It was shown by Hecht, Conrad, and Brückner that the velocity of the reaction between alcoholate and alkyl haloid in alcoholic solution obeys the bimolecular equation, but that the velocity-coefficient increases with the dilution. Steger proved further that the addition of sodium haloid diminishes the velocity-coefficient. The authors propose to explain these facts by considering the reaction as an ionic one, assuming not only ionisation of the alcoholate but also of the alkyl haloid. Experimental evidence for the second assumption is, however, still lacking. The fact that the velocity-coefficient remains constant in any given case, although sodium haloid (iodide) is being produced in the reaction, cannot be explained by assuming a combination between the ether and the sodium iodide simultaneously produced, as the authors show by special experiments. The authors reject the theory proposed by Nef to explain the mode of reaction of the alkyl haloids. F. G. D.

1113. *Velocity of Reaction and Free Energy.* **E. Brunner.** (Zeitschr. Phys. Chem. 51. pp. 106–107, Feb. 21, 1905.)—The equation, velocity of reaction = driving force/chemical resistance, does not hold for varying concentrations, if, with a large amount of dissolved substance, the driving force is taken as the diminution of free energy caused by exchanging $n_1$ molecules of *a*, $n_2$ of *b*, &c. If a substance taking part in the reaction is lacking, the driving force, but not the velocity of reaction, becomes infinitely great. So that in a homogeneous system quite free from the products of a possible reaction, this reaction would not take place with an infinitely great velocity in the first instant. T. H. P.

1114. *Rate of Formation, and Reaction with Hydriodic Acid, of Tribromphenolbromide.* **S. J. Lloyd.** (Amer. Chem. Soc., Journ. 27. pp. 7–15, Jan., 1905.)—Tribromphenolbromide is quantitatively reduced to tribromphenol by zinc and sulphuric acid, and may be estimated by a method based on this reaction. It is not a primary product of the action of bromine on phenol, but is formed by the gradual action of bromine water on tribromphenol. As the rate of this reaction is decreased by adding acid or potassium bromide, and increased by adding water or bromine (or by raising the temperature), it is probably due to the presence of hypobromous acid in the bromine water. Tribromphenolbromide is not quantitatively reduced to tribromphenol by hydriodic acid under conditions convenient for analysis, owing partly to the formation of other products. T. H. P.

1115. *Action of Sulphuryl Chloride on Mixed Organo-magnesium Compounds.* **B. Oddo.** (Accad. Lincei, Atti, 14. pp. 169–174, Feb. 5, 1905.)—

The action of sulphuryl chloride on magnesium phenyl bromide mainly proceeds in two stages, in the first of which the chloride of benzenesulphinic acid is formed: (1) $SO_2Cl_2 + Mg(C_6H_5)Br = MgBrCl + SO_2(C_6H_5)Cl$; (2) $SO_2(C_6H_5)Cl + Mg(C_6H_5)Br = C_6H_5Cl + O : S(C_6H_5) . OMgBr$. The last compound, when treated with water, yields benzenesulphinic acid. There are also formed small proportions of chlorobenzene and diphenyl, the latter resulting from a secondary reaction: $Mg(C_6H_5)Br + C_6H_5Br = C_6H_5 . C_6H_5 + MgBr_2$. This secondary reaction increases in amount as the complexity of the alkyl radical in the organo-magnesium compound increases. T. H. P.

1116. *Oceanic Salt Deposits.* 40. *Limits of Stability of Tachhydrite.* **J. H. van't Hoff** and **L. Lichtenstein.** (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 6. pp. 232–235, Feb. 9, 1905.)—Tachhydrite is formed from calcium and magnesium chlorides at 22°, according to the equation—

$$2MgCl_2\,6H_2O + CaCl_2 6H_2O = Mg_2Cl_6Ca . 12H_2O + 6H_2O.$$

The limiting solutions in contact with which tachhydrite can exist at 25° have now been determined. They are as follows:—

| Solution Saturated with Salt and | Contains per 1000 $H_2O$ | | | |
|---|---|---|---|---|
| | $CaCl_2$ | $MgCl_2$ | $K_2Cl_2$ | $Na_2Cl_2$. |
| (1) Magnesium chloride and tachhydrite | 90·5 | 51·5 | — | 1 |
| (2) „ „, carnallite and tachhydrite ............................ | 90·5 | 51·5 | — | 1 |
| (3) Calcium chloride and tachhydrite...... | 121·5 | 35·5 | — | 1 |
| (4) „ „, carnallite and tachhydrite .................................. | 121·5 | 34·5 | 2 | 1 |

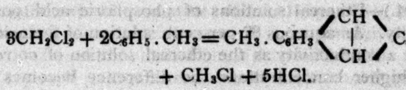
It will be noticed that a solution saturated with magnesium chloride and with tachhydrite does not dissolve potassium chloride, so that the solutions (1) and (2) have the same composition. When saturated with calcium, in place of magnesium, chloride a small amount of potassium passes into solution. It will also be noted that the amount of salt dissolved is never more than 1 mol. $Na_2Cl_2$ per 1000 $H_2O$. T. M. L.

1117. *Yellow and Red $As_2S_3$.* **H. Winter.** (Zeitschr. Anorg. Chem. 43. 2. pp. 228–235, Jan. 25, 1905. Chem. Laborat. der Bergakademie Berlin, Nov., 1904.)—By evaporating to dryness or freezing colloidal solutions of arsenic trisulphide a red "modification" is obtained. This red trisulphide can also be obtained by coagulating the colloidal solution with HCl, washing and drying, but not by precipitating a hydrochloric acid solution of arsenious anhydride with $H_2S$. The author considers that the colloidal solution contains the red, not the yellow form. Experiments were also made on the rate of coagulation of the colloidal solution by ammonium salts. The latter arranged according to diminishing velocity follow the order—chloride, sulphate, acetate, nitrate, carbonate. F. G. D.

1118. *Hydrolysis of Ammonium Salts.* **V. H. Veley.** (Chem. Soc., Journ. 87. pp. 26–33, Jan., 1905.)—The evolution of ammonia taking place on boiling solutions of ammonium salts, and the acidity of the solutions are the results of hydrolysis and not of direct dissociation. Three cases are possible in the hydrolysis of salts: (1) salts formed from a weak base and strong acid; (2) salts formed from a strong base and a weak acid, and (3) from a weak base and a weak acid. Ammonium salts, containing the relatively weak base ammonia, would probably be included only in classes (1) and (3). For the former it has been shown that the amount of hydrolysis is dependent on the dilution, while for the latter it is independent of the dilution. The author finds that the hydrolysis of ammonium salts actually presents these two cases, its amount being either dependent on the dilution or independent of the dilution when beyond a certain limiting value. The avidity with which the different acids retain ammonia in combination is analogous to their activity or avidity in the hydrolysis of methyl acetate and inversion of cane sugar; the relative, but not the absolute, order of magnitude is the same in all these three chemical changes. T. H. P.

**1119.** *Solutions of Salts of Ammonia and of Amines.* **H. Euler.** (Arkiv. Kem. Min. Geol., Stockholm, 1. pp. 133–142, 1904.)—The author's measurements of the solubility of aniline in water show that 100 gm. of water at 18° dissolve at 3·61 gm. of aniline. The solubility of aniline in solutions of certain chlorides and of sodium and potassium hydroxides of various strengths was also determined. The diminutions in the solubility rest for the most part on the physical action which in general determines "salting-out." In the case of ammonia, however, the formation of complex compounds plays a greater part. The freezing-point depressions of solutions of aniline and its hydrochloride in water have been determined; when the base and the salt are both present in low concentrations, the formation of complex compounds is slight, but this becomes more marked in the more concentrated solutions. T. H. P.

**1120.** *Action of Methylene Dichloride and Aluminium Chloride on Toluene.* **J. Lavaux.** (Comptes Rendus, 139. pp. 976–978, Dec. 5, 1904.)—As products of this reaction Friedel and Croft found ditolylmethane and dimethylanthracene, but no distinction was drawn between the isomers. The author has now isolated di-*m*- and di-*p*- tolylmethane, and the three isomeric dimethyl anthracenes, together with some $\beta$-methylanthracene, and a little benzene, the relative quantities depending on the amount of $AlCl_3$ present. When the proportion of the latter is small, much ditolylmethane is formed, and but little dimethylanthracene; as the quantity of catalyst increases, however, so does the amount of dimethylanthracene produced, a corresponding diminution taking place in the yield of ditolylmethane. The dimethylanthracene is shown to be formed at the expense of the ditolylmethane first produced, the complete reaction being represented by the equation—



$$3CH_2Cl_2 + 2C_6H_5.CH_3 = CH_3.C_6H_3 \left\langle \begin{matrix} CH \\ | \\ CH \end{matrix} \right\rangle C_6H_3.CH_3 + CH_3Cl + 5HCl.$$

The presence of benzene is accounted for by a partial demethylation of toluene under the influence of $AlCl_3$. Agitation of the liquid mass is found to greatly facilitate the reaction, a lower temperature being then required. W. H. Si.

**1121.** *Brown Modification of Colloidal Ferric Oxide.* **P. Nicolardot.** (Comptes Rendus, 140. pp. 310–312, Jan. 30, 1905.)—The formation of the complex combinations studied by Béchamp, or the soluble oxides of Graham and Péan de Saint-Gilles may be readily explained by assuming that the molecule of ferric oxide undergoes various condensations. Experiments have been made proving that this molecule can be obtained in different states of condensation, and have further shown the existence of four modifications of ferric oxide, different condensations of which produce brown, yellow, and red solutions. W. H. Si.

**1122.** *Influence of Aqueous Vapour upon the Reduction of Iron Oxides.* **O. Boudouard.** (Comptes Rendus, 140. pp. 40–42, Jan. 2, 1905.)—The author has carried out some laboratory experiments bearing upon the new method of working the blast-furnace process with dry air, as described by Gayley [see Abstract No. 267B (1905)]. The method of investigation was to pass carbonic oxide, or mixtures of CO and $CO_2$, over oxide of iron contained in a porcelain boat, at various temperatures, and by noting the change in weight with the dry and moist gases, to determine the influence of the aqueous vapour upon the reaction. Each experiment lasted one hour. In the first series of experiments, with the mixed gases, the following figures were obtained :—

| Temperature. | Percentage Loss of Weight, by $Fe_2O_3$. Dry Gases. | Moist Gases. |
|---|---|---|
| 400° | 0·87 | 0·45 |
| 530° | 4·3 | 3·8 |
| 800° | 4·0 | 2·65 |
| 925° | 5·6 | 4·4 |
| 1,050° | 6·5 | 6·9 |

In the second series of experiments, CO alone was employed, and the iron was used in the state of ferrous oxide—FeO. The results were as follows :—

| Temperature. | Percentage Loss of Weight, by FeO. Dry Gases. | Moist Gases. |
|---|---|---|
| 852° | 15·3 | 11·00 |
| 1,050° | 21·5 | 21·50 |

These results prove that the gases when dry are much more active than when moist, the gain being especially marked at the lower ranges of temperature. Since the reduction of $CO_2$ by the incandescent carbon is less energetic at the lower temperature, the net result is a considerable reduction in the consumption of coke in the blast-furnace process. J. B. C. K.

**1123.** *Electrical Conductivity of Ethereal Solutions of Phosphoric Acid.* **W. A. Plotnikow.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 36. No. 8a. pp. 1282–1288, 1904.)—Ethereal solutions of phosphoric acid possess considerable conductivity. An aqueous 87 per cent. solution of the acid has only three times as great a conductivity as the ethereal solution of corresponding concentration; at higher concentrations the difference becomes still less. With diminution of the concentration, the conductivity in ethereal solution falls much more rapidly than in aqueous solutions. A similar rapid fall in conductivity is observed on diluting other non-aqueous solutions, and it remains an open question what concentration should be employed in estimating the dissociating power of a solvent. The molecular conductivity diminishes continuously as the concentration diminishes. With rise of temperature, the specific conductivity increases. T. H. P.

**1124.** *Equilibrium Curves in the System :* p-*Bromotoluene*—p-*Dibromobenzene.* **W. Borodowsky** and **A. D. Bogojawlensky.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 36. pp. 559–566, 1904.)—Previous work of one of the authors on the specific heats of mixtures of *p*-bromotoluene and *p*-dibromobenzene having indicated a peculiarity in the melting-point curves for these substances, these curves have been investigated. The diagram of condition for mixtures of these two compounds is formed by the superposition of two types of melting-point curve: (1) a curve for isomorphus substances—mixtures of *p*-bromotoluene with *p*-dibromobenzene, and (2) a curve for substances forming a eutectic mixture—mixtures of *p*-dibromobenzene with *p*-bromotoluene. From the course taken by the curve, it is evident that the mixtures represent an example of incomplete isodimorphism or one-sided miscibility of two kinds of crystals. One part of the diagram corresponds with the eutectic mixture; at 36·8°, a crystalline mixture of the composition $2C_7H_7Br$, $C_6H_4Br_2$ is deposited, whilst the remainder of the diagram corresponds with the formation of isomorphous mixed crystals. The boiling-point curve and the curve of vapour composition for different mixtures of *p*-dibromobenzene and *p*-bromotoluene have also been studied; these curves confirm the existence of this new form of equilibrium for binary crystalline mixtures. T. H. P.

1125. *Physical Properties of Aqueous Salt Solutions in Relation to the Ionic Theory.* **A. A. Noyes.** (Technology Quarterly, 17. pp. 293–307, Dec., 1904. Address delivered before the St. Louis Internat. Congress of Arts and Sciences.)—This address contains a useful statement of the limits within which the experimental data with reference to the properties of aqueous salt solutions conform to the requirements of the ionic theory. No references are given, but it is stated that this defect will be remedied in a subsequent communication. The chief points are as follows: (1) The transference number is constant within 1 per cent. from N/200 to N/10 in the case of all salts accurately investigated [KCl, NaCl, HCl, $HNO_3$, $AgNO_3$, $Ba(NO_3)_2$, $K_2SO_4$, $CuSO_4$], except LiCl, $CdSO_4$, and the halides of divalent metals. (2) The ionisation values derived from the freezing-point depressions of KCl, NaCl, $K_2SO_4$, $Na_2SO_4$, and $BaCl_2$, agree with those deduced from the electrical conductivity within 2–3 per cent. between N/200 and N/4; the values for KCl agree very closely, the others are 2–3 per cent. higher at all concentrations. (3) The e.m.f.'s of concentration cells containing KCl and NaCl gave values for the coefficients of ionisation which are only about 1 per cent. too high over the range from N/600 to N/10. (4) The heat of solution of $KClO_4$ is only 1·1 per cent. less than the value calculated on the assumption that the conductivity ratio $\Lambda_s/\Lambda_\infty$ is equal to the true coefficient of ionisation. (5) The coefficients of ionisation deduced by either the electrical or the osmotic method do not conform even approximately with the law of mass action, but between the limits from N/5 to N/10000 the modified equation of Storch $c\,(1-\gamma) = K\,(c\gamma)^n$ (where $n > 1{\cdot}43 < 1{\cdot}56$) holds good not only for uni-univalent salts such as KCl, but for uni-bivalent salts such as $BaCl_2$, and indeed for salts of almost all types. This is remarkable, since the law of mass action would give $n = 2$, 3, 4, &c., for di-, tri-, and tetra-ionic salts, whilst actually $n = 1{\cdot}5$ (approx.) for all these salts. (6) The conductivity of mixtures conforms closely to the requirements of the ionic theory. (7) The decrease of ionisation with increasing concentration is roughly constant in the case of different salts of the same type; and (8) the un-ionised fraction at any definite molecular concentration is, for salts of different types, roughly proportional to the product of the valencies of the two ions. T. M. L.

1126. *Phenomena Occurring when the Plait-point Curve Meets the Solubility Curve.* **A. Smits.** (Zeitschr. Phys. Chem. 51. pp. 193–221, Feb. 28, 1905.

Anorg. Lab. d. Univ., Amsterdam, Sept., 1904.)—The phenomena which must occur are discussed by graphical (thermodynamical) methods, and it is shown that *retrograde solidification* must make its appearance. These results are verified by an experimental study of the system ether-anthraquinone, and lead to a complete explanation of the phenomena of solution of solids and liquids in compressed gases at temperatures above the critical temperature of the latter. F. G. D.

**1127.** *Freezing-point Depression in Dilute Solutions of Strongly Dissociated Electrolytes.* **H. Jahn.** (Zeitschr. Phys. Chem. 50. pp. 129–168, Dec. 16, 1904. II. Chem. Inst. der Univ., Berlin, July, 1904.)—The following table shows the relationship between the ionic concentrations *n*, deduced (1) from Kohlrausch's measurements of molecular conductivity $\mu$ (? at 18° C), and (2) from the author's measurements of the molecular depression of the freezing-point Δ :—

| Lithium Chloride. | | | Caesium Chloride. | | |
|---|---|---|---|---|---|
| *N.* | $n_1$ from $\frac{\mu}{\mu_\infty}$. | $n_1$ from Δ | *N.* | $n_1$ from $\frac{\mu}{\mu_\infty}$. | $n_1$ from Δ. |
| 0·09732 | 0·08185 | 0·08771 | 0·1041 | 0·09101 | 0·0885 |
| 0·07462 | 0·06392 | 0·06818 | 0·07719 | 0·06875 | 0·06718 |
| 0·05053 | 0·04432 | 0·04622 | 0·05182 | 0·04715 | 0·04623 |
| 0·03771 | 0·03359 | 0·03520 | 0·03890 | 0·03588 | 0·03541 |
| 0·02503 | 0·02272 | 0·02399 | 0·02560 | 0·02352 | 0·02369 |
| Sodium Chloride. | | | Potassium Bromide. | | |
| 0·1004 | 0·0853 | 0·0876 | 0·1018 | 0·08835 | 0·0866 |
| 0·07582 | 0·0656 | 0·0668 | 0·07642 | 0·06735 | 0·06590 |
| 0·05035 | 0·0446 | 0·0446 | 0·05087 | 0·04570 | 0·04486 |
| 0·03803 | 0·0341 | 0·0348 | 0·03831 | 0·03482 | 0·03423 |
| 0·02520 | 0·0230 | 0·0231 | 0·02541 | 0·02344 | 0·02323 |
| Potassium Chloride. | | | | | |
| 0·1002 | 0·08679 | 0·0869 | | | |
| 0·07576 | 0·06664 | 0·06661 | | | |
| 0·05043 | 0·04525 | 0·04476 | | | |
| 0·03777 | 0·03431 | 0·03450 | | | |
| 0·02540 | 0·02342 | 0·02330 | | | |

In the case of the chlorides of sodium and potassium there is a good agreement between 0·025-N and 0·1-N, but the conductivity gives in the case of lithium chloride smaller, and in the case of caesium chloride and potassium bromide larger, values for the ionic concentration than those deduced from the freezing-point depresssion. The concordant values obtained by the two methods are, however, by no means in accord with Ostwald's Law, according to which $n_1^2/(N-n)$ should be constant at all concentrations. In the case of sodium chloride the values of this function are—

| | | |
|---|---|---|
| At 0·3010 | 0·1004 | 0·02520-N |
| 1·274 | 0·600 | 0·250 |

and in the case of potassium chloride

| | | |
|---|---|---|
| At 0·3386 | 0·1002 | 0·02540-N |
| 1·096 | 0·568 | 0·259 |

To account for these discrepancies it is assumed (1) that the observed values for the conductivity at the highest dilutions are a little too high; by reducing the value of $\mu_\infty$ by about a unit, concordant values were obtained for the Ostwald function in the case of the last two or three dilutions; the constant may be taken as 0·16 for NaCl and 0·19 for KCl. (2) It is further assumed that at higher concentrations there are two disturbing influences depending (*a*) on the mutual influence between the ions and the undissociated molecules, and (*b*) on the mutual influence between the ions themselves. If $n$ is the number of gm.-mol. of water in the solution, the values of the constants may be taken as:—

$$a/n = -5\,;\ b/n = -3, \text{ for NaCl}$$
$$a/n = -4\,;\ b/n = -2, \text{ for KCl}$$

and $$\log\left(1 + \frac{N+n_1}{n}\right) = \frac{V^0}{R}\,\frac{T_0 - T}{T_0^2} + \frac{b}{2n^2}\,n_1^2 + \frac{a}{n_2}\,(N-n_1)n_1.$$

The introduction of these additonal constants into the equation gives a function which (unlike the original Ostwald function) remains constant up to the highest concentrations (0.3 N) examined. Confirmatory results were obtained by the study of concentration-cells. T. M. L.

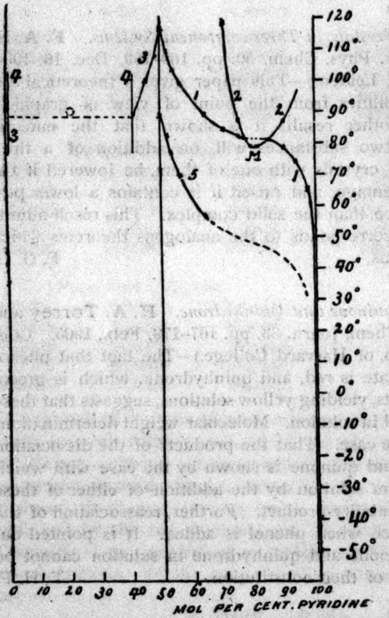
1128. *Isomorphous Mixed Crystals in Three-component Systems.* **F. A. H. Schreinemakers.** (Zeitschr. Phys. Chem. 50. pp. 169–199, Dec. 16, 1904. Anorg. Chem. Inst. der Univ., Leiden.)—This paper gives a theoretical discussion of the various possibilities from the point of view of graphical thermodynamics. Amongst other results it is shown that the eutectic solidification-temperature of two substances will, on addition of a third substance which forms mixed crystals with one of them, be lowered if the melt contains a greater percentage, and raised if it contains a lower percentage, of the third substance than the solid complex. This result admits of further generalisation, and corresponds to the analogous theorems which hold for two-component systems. F. G. D.

1129. *Dissociation of Phenoquinone and Quinhydrone.* **H. A. Torrey** and **H. Hardenbergh.** (Amer. Chem. Journ. 33. pp. 167–179, Feb., 1905. Contribution from the Chem. Lab. of Harvard College.)—The fact that phenoquinone, which in the solid state is red, and quinhydrone, which is green, both dissolve in organic solvents, yielding yellow solutions, suggests that these compounds become dissociated in solution. Molecular weight determinations in benzene show that this is the case. That the products of the dissociation of phenoquinone are phenol and quinone is shown by the ease with which phenoquinone is salted out from solution by the addition of either of these substances in excess of the solubility-product. Further, reassociation of the phenol and quinone takes place when phenol is added. It is pointed out that the reactions of phenoquinone and quinhydrone in solution cannot be relied on for the determination of their constitution. T. H. P.

1130. *Phenomena Occurring in the Case of Partial Miscibility of Two Liquids, One being Anomalous, especially Water.* **J. J. van Laar.** (Konink. Akad. Wetensch. Amsterdam, Versl. 13. pp. 573–588, Feb. 8, 1905. Proc. 7. pp. 517–531, Feb. 23, 1905.)—A mathematical discussion showing that certain complications occurring at the longitudinal plait on the $\psi$-surface are related to the association of one of the liquids. In the case of two non-associating liquids partial miscibility will only occur at ordinarily attainable temperatures when the critical pressures of the two components differ as much as possible.

The author traces the phenomena of partial miscibility exhibited by mixtures in which one component is an associating liquid, to the great variability with temperature of the (mean) molecular volume of the associating component, due to dissociation of the double molecules into single ones. F. G. D.

**1131.** *The System: Pyridine and Methyl Iodide.* **A. H. W. Aten.** (Konink. Akad. Wetensch. Amsterdam, Versl. 13. pp. 462–464, Jan. 5, 1905. Proc. 7. pp. 468–470, Jan. 25, 1905.)—Pyridine and methyl iodide can form the compound $C_5H_5N\,.\,CH_3I$, which possesses considerable stability. At 60° and higher it is rapidly formed in mixtures of the two components, but at the ordinary temperature only slowly. If the liquid mixtures are kept for some time the compound is formed with considerable evolution of heat, and separates at the ordinary temperature in the solid condition. The behaviour of the two components is shown in the Fig. At the right-hand side, Curve 1 is the melting-point or solubility curve of the compound, commencing with its melting-point, 117°, and extending to a eutectic point, very close to the melting-point of pyridine (−50°). At 81°, at concentrations 77·5 and 85·5 mols. per cent. of pyridine, the Curve 1 is interrupted owing to the separation of two liquid layers. The Curve 2 gives the composition of these two layers at different temperatures. The region of heterogeneous states enclosed by this curve expands towards higher temperatures. The fused compound is therefore miscible with pyridine only to a limited extent. Point M is realisable if separation of the solid compound does not occur. At the left side of the Fig. similar relationships are found. Curve 3 is the melting-point curve; Curves 4 are the two branches of the solubility curves of the two liquid layers. The region of immiscibility is here very great, being at 88° from 0·5 to 41 mols. per cent. of pyridine. No change in composition at higher temperatures was observed. Curve 5 is the solubility curve of a metastable form of the solid compound; it can only be partially determined in the presence of excess of pyridine. With a large excess a stable form was produced too easily. The chief point of interest in connection with this work is that two liquids which are miscible in all proportions may yield two sets of coexisting liquids owing to the formation of a chemical compound. This is the first observed instance of this. The sharp intersection of the melting-point curves, 1 and 3, at 117°, and the strong elevation of the boiling-



point after the combination (pyridine 116°, methyl iodide 42°, combined liquid 270°), show that even in the liquid state the compound is certainly for the greater part undissociated. Probably the partial miscibility of the combined liquid with its components is connected with the fact that the chemical nature of the compound differs so greatly from those of the components. A. F.

1132. *Relation of Vapour-pressure Lowering to Concentration in the Case of Aqueous Solutions.* **A. Smits.** (Zeitschr. Phys. Chem. 51. pp. 33–44, Feb. 21, 1905. Konink. Akad. Wetensch. Amsterdam, Feb. 27, 1904.)—Employing Rayleigh's manometer, the author confirms his previous result (obtained with the anilin-water manometer), that in the case of NaCl solutions the van't Hoff factor *i* at first diminishes and then increases with increasing concentration, the minimum occurring at a concentration of about 0·5-gm. mol. per litre. This result is in agreement with the freezing-point measurements of Jones and Getman. In the case of $NaNO_3$, solution *i* was found to exhibit a steady decrease with increasing concentration, *i* being, as before, calculated from the lowering of vapour-pressure. This result agrees also with that found by Jones and Getman from freezing-point measurements. In conclusion, the author draws attention to the remarkable result, that if the degree of dissociation be calculated from the vapour-pressure measurements, it follows the Ostwald dilution law in the case of $KNO_3$ but not in the case of $NaNO_3$ solutions. Except in the case of very dilute solutions, we have to deal with (*a*) association of solvent and solute ; (*b*) formation of complex ions, besides normal ionisation. A consideration of these factors suffices to explain the observed variations of *i*. Probably in the case of $KNO_3$ solutions, owing to the high electro-affinity of both ions, formation of neither complex ions nor "hydrates" occurs, so that the degree of ionisation, as calculated from the vapour-pressure measurements gives us correct values for the concentration of the constituents of the solution. F. G. D.

1133. *Effect of Temperature on Water of Crystallisation as Evidence for the Theory of Hydrates in Solution.* **H. C. Jones** and **H. P. Bassett.** (Chem. News, 91. pp. 133–134, March 24, 1905.)—In recent papers [see Abstract No. 3048 (1904)] the authors have laid special stress upon the relation between water of crystallisation and molecular lowering of the freezing-point as evidence for the theory of hydrates to account for abnormally great freezing-point depressions, and consequently abnormally great osmotic pressures shown especially by concentrated solutions of electrolytes. The authors quote an experiment presumably to prove that as addition of crystallised calcium chloride to a solution of cobalt chloride *dehydrates* the cobalt chloride, therefore the calcium chloride can combine in solution with more than six molecules of water. [Are the authors unfamiliar with the work of Donnan and H. Bassett, Jr. [see Abstract No. 270 (1903)], who have already proved that the change in colour of cobalt chloride solutions is not due to dehydration ?] The authors give a table of salts with the water of crystallisation, and draw the conclusion that the lower the temperature the greater will be the amount of water of crystallisation. This is regarded as important evidence in favour of the views put forward by Jones. A. F.

1134. *Dissociation of Cadmium Iodide.* **J. W. McBain.** (Zeitschr. Elektrochem. 11. pp. 215–223, April 7, 1905. Phys.-Chem. Inst., Leipzig, March, 1905.)—According to Hittorf, the apparent transport number of the anions is for certain salts, especially cadmium iodide, greater than 1, and the transport number of the kathions negative; double molecules, he thought, dissociated into $Cd^{\cdot\cdot}$ and $CdI_4''$. The author finds the observations by seven investigators, on the conductivity, freezing-point depression, and transport numbers, in good agreement, and he calculates from them that the complex anions $CdI_3'$—not $CdI_4''$—predominate in a solution of $Cd^{\cdot\cdot}(CdI_3')_2$, and that complex kathions and $CdI^{\cdot}$ are not present in large numbers. Hittorf's electrolysis of mixtures of KI and $CdI_2$ supports these views. The curve of the transport numbers rises, steeply at first, with increasing concentrations, and becomes parallel to the abscissa at the value 1·25. The influence of concentration on the mobility of the ions seems to be small. H. B.

1135. *Photo-electric Phenomena in Wet Silver Iodide.* **H. Scholl.** (Ann. d. Physik, 16. 2. pp. 193–237, Feb. 24, and 16. 3. pp. 417–463, March 14, 1905. Phys. Inst. d. Univ., Leipzig, Oct., 1904. Habilitationsschrift.)—A very extensive description of experiments concerned with the elucidation of the mechanism of the processes involved in the photo-electric effect, discovered by Becquerel in 1868, that a Pt plate coated with chloride, bromide, or iodide of silver, when immersed in acidulated water or in a solution of the corresponding alkaline haloid, undergoes a change of potential with respect to the liquid when the layer of silver haloid is exposed to light. If the plate is connected with another similarly prepared plate in the same liquid but in the dark, a current passes from the illuminated plate to the dark one along the connecting wire. The rise of potential causing the current, the variation of the absorption coefficient of silver iodide with wave-length, the influence of the colour of the light on the change of potential produced, the change of resistance of the cell when illuminated and when in the dark, are among the effects investigated, and the results obtained are summed up by the author as follows: In wet silver iodide permeated by an aqueous salt solution, several processes are at work, one or another of these predominating according to circumstances. With exposure to any part of the visible spectrum there is dissociation of the iodide, the amount of which varies with the absorptive power of the iodide. The dissociation is favoured by the presence of free iodine, which gives rise to free (probably negative) electrons, in addition to the ions of silver iodide. These electrons have a motion in the solid silver iodide, to which they communicate a metallic conductivity, their velocity being far greater than that of electrolytic ions; in silver iodide placed in the dark they are quickly absorbed, but are capable of motion, until absorption takes place, over paths more than 1/100 mm. long. A second process running simultaneously with the first and influenced by the same causes, especially by the action of light, produces a new substance which, dissolved in the solid iodide and diffusing through it with great rapidity, is not produced from the iodide either by the taking up or giving off of free iodine. This substance is also photo-electrically excitable, and exposure to light causes the production from it of new carriers of electricity, its sensitiveness to the spectrum being, however, quite different from that of normal silver iodide. This substance is unstable, not only under the action of light, but also in the dark, undergoing a transformation which probably leads to the end-products. As a result of this formation and transformation there is an equilibrium value for its concentration which depends on the intensity and colour of the light employed, being highest in the violet and lowest in the red. To these dissociation processes must be ascribed a part at least of the illumination potential-difference observed by Becquerel, but another and perhaps more important part is due to the setting free of iodine, probably a reaction following or accompanying one of the above processes, the iodine having the effect of raising the potential of the Pt electrode with respect to the electrolyte. G. E. A.

**1136.** *Position in the Voltaic Series of the Metals of the Alkalies and Alkaline Earths at High Temperatures.* **H. Danneel** and **L. Stockem.** (Zeitschr. Elektrochem. 11. pp. 209–211, April 7, 1905.)—The authors briefly discuss the advantages and disadvantages of using salt mixtures in the electrolysis of fused salts. The addition of fluor-spar to chlorides introduces impurities, and the chlorine liberated is not free from fluorine. Referring to the researches of Matthiessen, Liès-Bodart and Jobin, and Moissan, the authors point out that the position of the metals K, Na, Ca must change at higher temperatures. Fusing these metals with chlorides and also iodides, they found that Na does not reduce Ca from those salts at temperatures above 800° C.; at lower temperatures an alloy of Na and Ca results. They do not confirm Arndt's statement that Ca decomposes fused KCl; on the other hand, K reduces Ca, but not Sr, from fused chloride. The experiments, which do not comprise any potential measurements, were made at Aachen, and are to be continued. H. B.

**1137.** *Electro-affinity Relations between Thallic and Thallous Compounds.* **J. F. Spencer** and **R. Abegg.** (Zeitschr. Anorg. Chem. 44. 4. pp. 379–407, April 4, 1905. Anorg. Abt. des Universitätslaborat. Breslau.)—The results of the authors' experiments, which are given in detail, lead to the following conclusions: Thallic salts have a tendency to pass into thallous salts expressed by the equation: $Tl^{\cdots} \longrightarrow Tl^{\cdot} = 1{\cdot}199 + 0{\cdot}029 \log (Tl^{\cdots}/Tl^{\cdot})$. Dilution of a mixture of thallic and thallous sulphates or their nitrates has no influence on the e.m.f., that is, the concentration ratio $Tl'''/Tl'$ is constant, and both forms are strongly ionised. The constant P in the potential equation is, for $Tl^{\cdots}/Tl^{\cdot}$ chlorides, nearer to the reduction end of the pressure series than for the nitrates or sulphates, and changes on dilution in the direction of greater oxidisability. The tendency of the thallic ion to form complexes with anions increases continuously with the following groups: Chlorine, tartrate, acetate, $CNO'$, $(COO)''$, $Br'$, NO , $I'$, $CNS'$, $SO_3''$, $CN'$, $S_2O_3''$. The hydrolytic reaction, $Tl(NO_3)_3 + 3H_2O = Tl(OH)_3 + 3HNO_3$, is reversible, and gives for the constant of the mass action law, $(HNO_3)^3/Tl(NO_3)_3 = 13{\cdot}6$. The solubility product for thallic hydroxide is $L = 10^{-52{\cdot}83}$, and the solubility of thallic hydroxide has the value $10^{-13{\cdot}32}$ mols. Thallous nitrate is oxidised by oxygen to the extent of about 2 per cent. when equilibrium sets in, platinum acting as a catalyser. The oxidation potential of the oxygen is hence $1{\cdot}1385 \pm 0{\cdot}001$ volts. Thallic and thallous salts are in equilibrium with metallic thallium, if the concentration ratio, $Tl^{\cdots}/Tl^{\cdot} = 10^{-52{\cdot}2}$. T. H. P.

**1138.** *Electric Kataphoresis of Distilled Water.* **A. Cruse.** (Phys. Zeitschr. 6. pp. 201–204, April 1, 1905. Extract from the Göttinger Dissertation.)—Attempts have been made to apply the action of electric endosmose to industrial problems connected with the separation of a liquid from solid bodies. The paper deals with the dependence of the kataphoresis, or electric transference, of distilled water on temperature. When distilled water is electrolysed in a vessel with a porous partition separating the electrodes, the quantity of water transported through the diaphragm in a given time increases, with rise of temperature, to a maximum at 35° to 40°, and then decreases, first rapidly, then slowly. Further, the Wiedemann-Quincke relation between quantity of transferred liquid and current density does not hold for large current densities. The experiments seem to support Lamb's assumption of a slipping factor (Phil. Mag., 1888) rather than the theories of Helmholtz and Smoluchowski, in which no slipping of the liquid is assumed. G. E. A.

1139. *Recent Investigations Bearing on the Theory of Electrolytic Dissociation.* **L. Kahlenberg.** (Faraday Soc., Trans. 1. pp. 42–53; Discussion, pp. 53–64, Jan., 1905. Phil. Mag. 9. pp. 214–229, Feb., 1905.)—The "recent investigations" deal with experiments carried out by the author and his pupils. The object of the paper is to show that the ionic theory must be discarded, because the author cannot reconcile these facts with it. [The "ionic theory," as it appears to be understood by the author, is the ionic theory of 1889, and his arguments are the arguments of 1889. He appears to be unaware of the fact that since that date the ionic theory has undergone (and is undergoing) extensive development and modification, and that most of the facts which he enumerates are capable of explanation by means of this extended theory. It is difficult to believe that the author could have written this paper had he been conversant with the modern work referred to.] F. G. D.

1140. *Dissociation of Ternary Electrolytes.* **K. Drucker.** (Zeitschr. Elektrochem. 11. pp. 211–215, April 7, 1905.)—The author objects that Kümmel [see Abstract No. 684 (1904)] neglects complex ions in his researches on isohydry as an aid in the determination of the dissociation of ternary electrolytes, and raises other objections. The author had in 1901 proposed the following method of determining the concentration of single ions: When a polyvalent electrolyte (*e.g.*, $MgCl_2$) only forms ions which contain the polyvalent component once only (Mg, not $Mg_2$), then the concentration of the monovalent ion (Cl) results directly as the difference of the analytical and the osmotic concentrations. How this can be done he shows with the aid of tables on the constants of various chlorides, sulphates, and nitrates. When conductivity and freezing-point depressions agree perfectly, the transport number will be constant. This applies to $K_2SO_4$, less to the other salts. As long, therefore, as the transport number justifies the assumption of a dissociation like $AB_2 \rightleftharpoons A^{\cdot\cdot} + 2B'$, conductivity and freezing-point depression will go together, as Arrhenius demands, even in concentrations for which the uncorrected law of mass action is not applicable. It is, however, striking that the depression which measures only one ion gives higher values than the conductivity. H. B.

1141. *The Aluminium Rectifier.* **W. D. Bancroft.** (Amer. Electrochem. Soc., Trans. 6. pp. 13–21; Discussion, pp. 21–24, 1904.)—The communication concerns the experiments of Charters [see Abstract No. 906 (1905).]—In the *discussion,* **Burgess** remarked that the instantaneous observations which Hambuechen and he had made were preferable to Charters' method. **C. Hering** inquired about the phase lag, and pointed out that the electrodes would be earthed by the cooling water flowing through them. The **Author** replied that he believed in a counter-electromotive force rather than a resistance; the current flowed through the semi-permeable film; the perforations (Burgess) were unimportant. H. B.

**1142.** *Capacity and Resistance of Aluminium Anode Films.* **C. McC. Gordon.** (Phys. Rev. 20. p. 128, Feb., 1905. Abstract of paper read before the Amer. Phys. Soc., Dec., 30, 1904.)—The author points out that most of the measurements on aluminium anode films have been made with direct currents. He uses alternating current and a Wheatstone bridge, this enabling him to independently measure the capacity, resistance of film, and resistance of electrolyte at the same time. It is found (1) that the capacity of the film is inversely proportional to the volts used to form it; (2) that for water solutions the capacity varies but slightly with the nature of the electrolyte; (3) that the capacity of films formed in molten electrolytes is much less than those of water solutions, but (4) increases rapidly after the voltage applied to form the film is removed; (5) that the resistance of the films is much less than is given by many investigators. It is noticeable that (2) is not in accord with Mott's theory, that the films would be thinner the greater the valence of the acid radical of the electrolyte [see Abstract No. 447 (1905)]. L. H. W.

**1143.** *Last Researches of G. Bodländer. Electrometrical Estimation of Carbon Dioxide. Preparation of Caustic Alkali from the Carbonate.* **R. Lucas.** (Zeitschr. Elektrochem. 11. p. 185–187, March 24, 1905.)—As regards the first research, compare Abstract No. 651 (1905). The second paper concerns the reaction: $\mathrm{K_2CO_3 + Ca(OH)_2 \rightleftarrows CaCO_3 + 2KOH}$, which continues, because $\mathrm{Ca(OH)_2}$ is more soluble than $\mathrm{CaCO_3}$, until the solubility produced, $(\mathrm{Ca}^{\cdot\cdot}).(\mathrm{OH}')^2 = \mathrm{K}_1$, attains a constant value. For $\mathrm{CaCO_3}$ dissolved in soda we have similarly $(\mathrm{Ca}^{\cdot\cdot}).(\mathrm{CO}^{3}) = \mathrm{K}_2$. The formation of alkali caustic will proceed until $(\mathrm{Ca}^{\cdot\cdot}) = \mathrm{K}_1/(\mathrm{OH}')^2 = \mathrm{K}_2/(\mathrm{CO}_3'')$, or $(\mathrm{OH}')^2/(\mathrm{CO}_3'') = \mathrm{K}_1/\mathrm{K}_2 = \mathrm{K}_3$. This last quotient (caustic/carbonate) determines the yield which is proportional to the $(\mathrm{OH}')$ concentration, and is somewhat improved and quickened by heating. The phase-rule and the formation of Gaylussit, $\mathrm{Na_2CO_3 \,.\, CaCO_3 \,.\, 5H_2O}$, are also considered. Strontium hydrate should answer better than the calcium and barium hydrates. The experiments were made by Lieban. H. B.

**1144.** *Anode Reactions in the Electrolysis of some Salts of Thallium, Bismuth, and Silver.* **Margaret Bose.** (Zeitschr. Anorg. Chem. 44. 3. pp. 237–266, March 24, 1905.)—The author branches two circuits, each with its own battery, from the anode, mostly a Pt-wire: the electrolytic trough circuit and the compensation circuit; the latter contains the normal electrode, separated by several vessels from the trough. Measurements were taken half a minute or a minute after closing the circuit. Thallium nitrate yields two decomposition points, at 1·428 volts, corresponding to $\mathrm{Tl_2O_3}$, and at 1·08 volts, possibly corresponding to another oxide; thallium sulphate gives only the higher point. Bismuth-nitrate yields a decomposition point at 1·86 volts (yellow oxide, $\mathrm{Bi_2O_3}$). Silver nitrate and sulphate give 1·573 and 1·53 volts (the slight difference is explained), corresponding to the same oxide, $\mathrm{Ag_2O_2}$, which looks like a metal, and seems to conduct metallically. The compounds between this peroxide and the respective acids (which others have assumed) do not appear to exist. H. B.

1145. *Electrolytic Behaviour of Fused Copper Sulphide.* **G. Bodländer** and **K. S. Idaszewski.** (Zeitschr. Elektrochem. 11. pp. 161–182, March 24, 1905. Elektrochem. Laborat. der techn. Hochschule, Braunschweig.)—The authors apply a muffle furnace of Timme, Berlin, built up of iron and slabs of fire-clay, platinum wires being inserted into many perforations of the slabs. The furnace is put on one of its sides to receive the crucible or V-tube, in which the powdered $Cu_2S$ is fused by means of carbon electrodes, partly protected by porcelain tubes. The melting-point of $Cu_2S$ is 1,091° (Pt and Pt-Rh couple); the fused sulphide dissolves metallic copper and secretes it again on solidifying. At ordinary temperature $Cu_2S$ is a weak electrolytic conductor; at 110° some CuS is formed under spontaneous heating, and this CuS conducts like a metal (Hittorf confirmed). For this reason the electrolysis of the fused sulphide gives only a very poor yield of $Cu''$ and $CuS'$. In mixtures of $Cu_2S$ and Cu, the CuS always present is transformed into $Cu_2S$, and the electric resistance increases therefore. Experiments were also made with mixtures, in various proportions, of $Cu_2S$ and $K_2S$ (decomposition pressure of fused $K_2S$, 1·65 volts), and $Na_2S$ (1·62 volts), sometimes under further addition of NaOH. Some Cu is liberated as a secondary product at the kathode, and the complex anion NaCuS collects at the anode; this compound forms steel-blue needles. Technically the electrolysis of fused $Cu_2S$ and of $(Cu_2S + Na_2S)$ seems hopeless. H. B.

1146. *Electrolytic Preparation of p-Aminophenol.* **F. Darmstädter.** (Zeitschr. Elektrochem. 11. pp. 274–275, May 5, 1905.)—In the electrolytic reduction of nitrobenzene to *p*-aminophenol, the concentrated sulphuric acid used may be advantageously replaced by 80 per cent. acid, the nitrobenzene being then suspended in the liquid. By this means the diaphragms and other portions of the apparatus are less attacked, and the loss of acid by dilution is diminished. Excess of the nitrobenzene must be always present in order to avoid reduction to aniline. Derivatives of *p*-aminophenol may be similarly prepared. (D.R.-P. 154086.) T. H. P.

1147. *Electrolytic Purification of Cobalt and Nickel.* **W. D. Bancroft.** (Amer. Electrochem. Soc., Trans. 6. pp. 39–43; Discussion, p. 43, 1904.)—The paper gives the results of a number of experiments in the separation of cobalt and nickel by electrolysis in an alkaline tartrate solution. A Classen dish was used as kathode, and a needle anode. No diaphragm was employed. Details are given of all tests employed, and the precautions taken. The author summarises the results as follows: (1) It is possible to obtain nickel and cobalt pure from an alkaline tartrate solution, if one is willing to take the time and pains. (2) The difficulty is due, in part, to the formation of cobaltic salt in the solution. J. L. F. V.

1148. *Electrostenolysis and Faraday's Law.* **T. W. Richards** and **B. S. Lacy.** (Amer. Chem. Soc., Journ. 27. pp. 232–233, March, 1905.)—Electrostenolysis, or the deposition of certain metals in capillary tubes during the passage of a current, occurs as a rule only under circumstances capable of producing considerable endosmose, namely, when the fall of the potential in the capillary is great. After the capillary has been lined or plugged with deposited metal its ends act as minute secondary electrodes within the liquid, giving rise to secondary kathodic and anodic reactions. The interposition of a porous cup (or system of capillaries) has been recently suggested as an essential part of any accurate electrolytic apparatus for measuring electric quantity [see Abstract No. 1926 (1902)], and the experiments described in the present paper are for the purpose of ascertaining whether the phenomenon of electrostenolysis has any influence on the mechanism of the normal deionisation of the metal. It is found that neither the weight of the true kathode deposit nor the exact applicability of Faraday's law is affected in any way. T. H. P.

**1149.** *Electrolytic Chromium.* **H. R. Carveth** and **W. R. Mott.** (Journ. Phys. Chem. 9. pp. 231–256, March, 1905.)—From the authors' experiments it appears that the presence of chromous salt is essential to the successful deposition of the metal from its chloride or sulphate solutions. This is proved by showing: (1) that the current does work in reducing the chromous to the chromic salts; (2) that it is necessary to electrolyse the chromic salts some time before the metal can be deposited with any considerable efficiency; and (3) that the efficiency is destroyed by oxidation of the chromous salt. Temperature has a very decided influence on the efficiency of deposition, and for each special set of conditions there seems to be a temperature at which the loss in efficiency caused by the decomposition of the chromous salt is balanced by increased efficiency caused by other factors. Thus it is found that after the sulphate has been electrolysed for some time, rise of temperature increases the efficiency, as also does lowering of the current density; similar effects are observed with a chloride solution between 0° and 16°. The more concentrated the solution the higher the temperature which may be advantageously employed. The nature of the anode solution affects the yield very considerably, probably owing to the diffusing of the anolyte into the kathode chamber. On continued electrolysis of the solutions of chromic salts the efficiency rises from zero to a practically constant value; this is accounted for by assuming that the absolute and relative masses of the chromous and chromic salts have, under the conditions employed, become practically constant in the solution. The current efficiency will be affected by any factor tending to change these relations, *e.g.*, change of temperature, increase of acidity, change of concentration, or the presence of catalytic agents, such as toluene or petroleum ether. As it is conceivable that, in reducing from the higher stages of oxidation, a solution from which metal can be deposited may not be obtained, in all cases where it is desired to obtain good current efficiencies in the deposition of metal, solutions should be used in which the metal exhibits its lowest valency. The quality of the deposit is always bad when the current efficiency is less than 5 per cent.; an acid bath favours hard, strong deposits, but causes lower efficiencies.

T. H. P.

**1150.** *Electrolytic Raffination of Lead in Fluosilicate Solutions.* **H. Senn.** (Zeitschr. Elektrochem. 11. pp. 229–245, April 14, 1905.)—The author finds that the improvement of the lead deposit obtained in Betts' process [see Abstract No. 3334 (1904)] by the addition of gelatine is not merely due to the gelatine; for in solutions of nitrate and of acetate of lead the gelatine has hardly any effect. He agitates his electrolyte with the aid of an electric motor, and uses anodes of crude lead and lead alloys, and also of cadmium, and kathodes of platinum or iron. Electrolytes containing 11 per cent. of $H_2SiF_6$, 4 to 8 of Pb, 2·5 of Cd, and 0·1 gm. per litre of gelatine for the lead bath and 0·3 gm. for the cadmium bath, give good plate deposits of lead or cadmium with current densities of from 0·5 to 1·5 amp./dm.$^2$; the deposits deteriorate when the dilution is carried too far. Alloys of lead and other metals also give pure lead, and leave an anode mud when electrolysed in fluosilicate baths. In the case of copper this mud contains still 10 per cent. of Pb. Alloys of Pb and Bi (with 12 per cent. of Bi) leave with currents of the mentioned density an anode residue with 20 per cent. of Bi; from richer Bi-alloys stronger currents dissolve some Bi which is re-deposited; antimony alloys behave similarly. Alloys of lead and 10 per cent. of platinum—technically important because lead alloys are prepared for separating the platinum metals—yield pure lead and a crystalline anode precipitate of $PtPb_2$, which can be dissolved in nitric acid, leaving a residue of iridium. The yield of these electrolyses are very good; some of the $PbSiF_6$ is, however, destroyed at the anode, whose mud contains $SiO_2$ and $PbF_2$. H. B.

## REFERENCES.

1151. *Atomic Weight of Silicon.* **W. Becker** and **J. Meyer.** (Zeitschr. Anorg. Chem. 43. 2. pp. 251–266, Jan. 25, 1905. Chem. Inst. d. Univ., Breslau.)—$SiCl_4$ was purified by freezing out in liquid air, weighed in small glass bulbs, and decomposed with ice-water in a closed platinum crucible. The $SiO_2$ was weighed. Final result, $Si = 28{\cdot}21$ $(O = 16)$. F. G. D.

1152. *Atomic Weight of Iodine.* **P. Köthner** and **E. Aeuer.** (Chem. News, 91. pp. 37–38, Jan. 27, 1905. Liebig's Ann. d. Chemie, 337. p. 362, 1904.)—The authors discuss the work of Baxter [see Abstract No. 219 (1905)]. The mean of all the determinations, 41 in number, of the atomic weight of iodine by Scott, Ladenburg, Baxter, and the authors is 126·010 $(H = 1)$ or 126·970 $(O = 16)$. T. H. P.

1153. *Atomic Weight of Cadmium.* **G. P. Baxter** and **M. A. Hines.** (Amer. Chem. Soc., Journ. 27. pp. 222–231, March, 1905.)—By determining the value of the relation $CdCl_2 : 2AgCl$, numbers between 112·393 and 112·445 are obtained for the atomic weight of cadmium, while the weight of silver combining with the chlorine in cadmium chloride gives the mean value $Cd = 112{\cdot}462$ $(Ag = 107{\cdot}92)$. T. H. P.

1154. *Valency of the Hydrogen Atom.* **de Forcrand.** (Comptes Rendus, 140. pp. 764–767, March 20, 1905.)—The author points out that, by assuming that the hydrogen atom and atoms of other supposed monovalent elements are divalent, a ready explanation is obtained for the existence of such compounds as $Ag_2F$, $Ag_4O$, $ICl_3$, $SF_6$, &c., and of molecular combinations. T. H. P.

1155. *Complexity of Beryllium.* **C. L. Parsons.** (Amer. Chem. Soc., Journ. 27. pp. 233–237, March, 1905.)—The author criticises the work of Pollok [see Abstract No. 846 (1905)]. The high atomic weight obtained by Pollok might well have been arrived at by a loss of chlorine from the chloride owing to the action of water. There is, hence, no evidence of the complexity of beryllium. T. H. P.

1156. *Thermochemical Rules Relating to the Possibility and Prediction of Results.* **Berthelot.** (Comptes Rendus, 139. pp. 1005–1009, Dec. 12, 1904.)—A theoretical paper summarising the views of the author on the subject. W. H. Si.

1157. *Relation of Physical Chemistry to Physics and Chemistry.* **J. H. van't Hoff.** (Journ. Phys. Chem. 9. pp. 81–89, Feb., 1905. Address delivered before the St. Louis Internat. Congress of Arts and Sciences, Sept. 22, 1904.)—In characteristically concise language van't Hoff here answers the following questions:

I. What has physical chemistry done for our ideas concerning matter? II. What has it done for our ideas concerning affinity? Under heading I. it is shown how, in the hands of Lavoisier, Gay-Lussac, Avogadro, Dulong and Petit, Helmholtz, Bunsen and Kirchhoff, Mitscherlich, Pasteur, Raoult, Arrhenius, &c., physical methods as applied to chemistry have led to an ever-increasing knowledge of matter. Under heading II. we get a very short but masterly sketch of the historical development of our ideas on affinity. The problem of affinity is the predominant note of modern physical chemistry, and has introduced physical principles into the study of chemistry, just as the earlier development was due to the introduction of physical methods. F. G. D.

**1158.** *Decomposition of Hydrated Mixed Crystals.* II. **R. Hollmann.** (Zeitschr. Phys. Chem. 50. pp. 567–594, Jan. 24, 1905.)—The paper consists mainly of an elaborate classification of hydrated mixed crystals into 15 groups, arranged in four classes according to their behaviour when the temperature is raised. A few examples are given in illustration. [See also Abstracts Nos. 2289 (1902) and 1495 (1903).] T. M. L.

**1159.** *Hypochlorous Acid.* III. *Formation and Decomposition of Hypochlorous Acid.* **J. Sand.** (Zeitschr. Phys. Chem. 50. pp. 465–480, Dec. 30, 1904. Inst. für physikal. Chemie, Göttingen.)—Measurements were made of the velocity of formation of chlorine from chloric and hydrochloric acids, and of chloric acid from chlorine and hydrochloric acid $HClO_3 + 5HCl \rightleftarrows 3Cl_2 + 3H_2O$. From the observed velocities at 70° the equilibrium constant for this temperature was deduced, and thence, by means of the known heat changes accompanying the action, the equilibrium constant at 20° C. [See also Abstract No. 428 (1905).] T. M. L.

**1160.** *Preparation and Properties of Colloidal Mixtures.* **A. A. Noyes.** (Amer. Chem. Soc., Journ. 27. pp. 85–104, Feb., 1905.)—A *résumé* of our present knowledge of this subject. T. H. P.

**1161.** *On Certain Heats of Dilution.* **J. E. Trevor.** (Journ. Phys. Chem. 9. pp. 90–109, Feb., 1905.)—This is a mathematical paper, treating the subject from the point of view of Gibbsian thermodynamics. It does not admit of a brief Abstract. The subjects discussed are: The Potential of a Component; The First Derivatives of the Thermodynamic Potential; Osmotic Pressures and Heats of Dilution; Formulation of Heats of Dilution. F. G. D.

**1162.** *Solubility of Barium Sulphate.* **F. W. Küster** and **G. Dahmer.** (Zeitschr. Anorg. Chem. 43. 3. pp. 348–349, Feb. 9, 1905.)—Barium sulphate is upwards of 120 times as soluble in saturated chromic chloride solution as in pure water, and in presence of hydrochloric acid, 450 times as soluble as in water. T. H. P.

**1163.** *Complexity of Dissolved Sulphates.* **A. Colson.** (Comptes Rendus, 139. pp. 857–859, Nov. 21, 1904.)—The lowering of freezing-point produced by 0·75 gm.-mol. $CuSO_4$ in 2 litres is 0·70°. That produced by the equivalent amount of sulphuric acid is 1·51°. This number is approximately double the former. Hence the former solution contains the molecule $[CuSO_4]_2$. Comment on this reasoning is superfluous. F. G. D.

**1164.** *Isomerisation.* **M. Delacre.** (Acad. Roy. Belg., Bull. pp. 950–954, 1904.)—The phenomena of isomerisation are divided by the author into two classes: (1) Those in which the action is complete and non-reversible, the final product being quite distinct from the initial one. (2) Those where the action is incomplete and reversible, as in the formation of pinacolin. With isomerisation of the second

type, the product may be a mixture of two compounds in chemical equilibrium, and, according to the author, this only bears a superficial resemblance to tautomerism.
T. H. P.

1165. *The Formation of Ammonia from its Elements.* **F. Haber** and **G. van Oordt.** (Zeitschr. Anorg. Chem. 43. 1. pp. 111–115, Jan. 16, 1905. Chemisch-techn. Inst. der techn. Hochschule, Karlsruhe.)—Perman [see Abstract No. 2923 (1904)] found that when ammonia is heated to a red heat complete decomposition occurs. The authors here give a few experiments from a more complete paper to be published later, in which they show that the equilibrium at about 1,020° C. is given by the expression—

$$K = \frac{(p_{N_2})^{1/2} \times (p_{H_2})^{3/2}}{p_{NH_3}} = \frac{(0{\cdot}25)^{1/2} \times (0{\cdot}75)^{3/2}}{0{\cdot}12 \times 10^{-3}} = 2706.$$

A. F.

1166. *Time Magnitudes of Formation of Complexes, Constants of Complexes, and Atomic Dimensions.* **G. Bodländer.** (Zeitschr. Elektrochem. 10. pp. 604–607, Aug. 12, 1904. Elektrochem. Laborat. der techn. Hochschule, Braunschweig.)—The author takes up the discussion of the reality of the minimal concentrations of ions in complex ions, and indicates some possible ways of getting over the difficulty raised by Haber. [See Abstract No. 2781 (1904).] His conclusion is that the small concentrations are not a fiction, but a reality.
A. F.

1167. *Condition of Metallic Solutions.* **J. Bronn.** (Ann. d. Physik, 16. 1. pp. 166–171, Jan. 26, 1905.)—A valuable summary is given of observations made with reference to the nature of solutions of the metals in liquid ammonia. The conclusion is drawn that these liquids contain the metal in the ideal condition of a perfect colloid, since the solutions are much more stable than those of other colloids and exhibit a change of colour, but no decomposition, when electrolysed. T. M. L.

1168. *Molecular Weight Determination in Solid Solutions.* IV. *Vaporisation of Isomorphous Mixtures of* p-*dichloro- and* p-*dibromobenzene.* **F. W. Küster.** (Zeitschr. Phys. Chem. 51. pp. 222–242, Feb. 28, 1905.)—Measurements of the total and partial vapour-pressures in the gas phase in equilibrium with the isomorphous mixtures. Solubility-measurements in a mixture of alcohol and water were also made.
F. G. D.

1169. *Decomposition of Ammonium Nitrite.* **A. A. Blanchard.** (Zeitschr. Phys. Chem. 51. pp. 117–122, Feb. 21, 1905.)—The author replies to the criticisms of Arndt [see Abstract No. 677 (1904)] on his former paper [Abstract No. 516 (1903)].
T. H. P.

1170. *On Real and Apparent Freezing-points and Freezing-point Methods.* **M. Wildermann.** (Ann. d. Physik, 16. 2. pp. 410–415, Feb. 24, 1905. Davy-Faraday Lab. of the Royal Institution, London.)—A critical discussion of Hausrath's paper on a "Differential Method of Determining Small Freezing-point Depressions" [see Abstract No. 807 (1903).]
D. H. J.

1171. *Use of a Rotating Anode in the Electrolytic Estimation of Zinc.* **L. H. Ingham.** (Amer. Chem. Soc., Journ. 26. pp. 1269–1283, Oct., 1904.)—The author gives the best conditions of working for the electrolytic estimation of zinc in zinc blende. The paper does not lend itself to concise abstraction. T. H. P.

1172. *Dissociation of Ternary Electrolytes.* **G. Kümmell.** (Zeitschr. Elektrochem. 11. pp. 94–99, Feb. 3, 1905. Phys.-chem. Universitätslaborat., Rostock, Jan., 1905.)—The author has already [see Abstract No. 684 (1904)] explained his isohydric method of studying the dissociation of ternary electrolytes. In the present paper he gives further experimental cases, and concludes that the isohydric method is very well suited to give the mean value for the concentration of ion-complexes. D. H. J.